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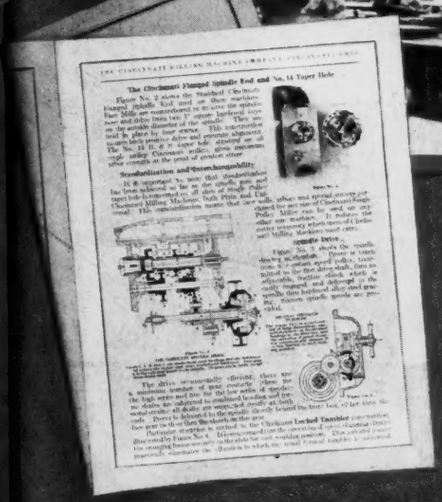

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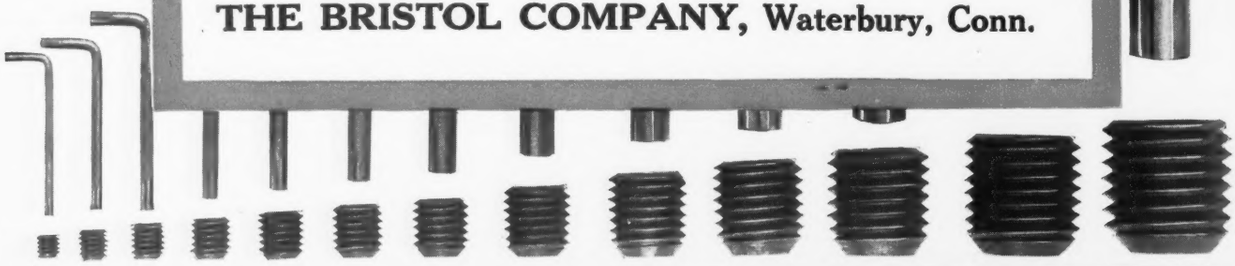

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A Modernized Apprentice System

How Apprentices are Trained by the Warner & Swasey Co., in Shop and Classroom Work

MORE than forty years ago the Warner & Swasey Co. Cleveland. Ohio, instituted a regular apprenticeship system in its plant. Ever since then apprentices have been thoroughly and systematically trained in this shop by methods that from time to time have been further developed and amplified to meet the more exacting needs of the machine-building industries. If anyone questions the possibility of conducting a successful apprentice system, this plant will convince him that it can be done. The best evidence of the results obtained is found in the fact that this company has not only continued its apprentice training during so many years, but developed it until it includes approximately one hundred apprentices when the plant is operating at full capacity. Furthermore, the apprenticeship, which originally consisted only of shop training, has been developed until it provides not only very thorough training in all shop processes, but also a well-rounded course of classroom studies, including mathematics, mechanics, drawing, and elementary machine design, and a number of other subjects relating to the methods and practices of the machine shop as well as to good citizenship.

The plan is recognized by the company as of great importance in providing skilled mechanics and in the development of trained men for the higher positions within the organization. As to specific results, those who have been in close touch with this apprentice system for years state that the productive efficiency of the apprentices themselves, because of their training and school instruction, compares favorably with that of the average shop man on similar classes of work. During periods of labor shortage, when the percentage of labor turnover is usually high, the permanency of the apprentice is also an important factor in his favor. Furthermore, the length of the apprenticeship period develops a spirit of comradeship and cooperation between the apprentices, which results in productive efficiency and a spirit of loyalty which is invaluable in any factory organization.

Does it Pay to Train Apprentices?

The objection frequently raised to any apprenticeship system is that as soon as the apprentice has been trained, he will leave the plant that has spent time and effort on his

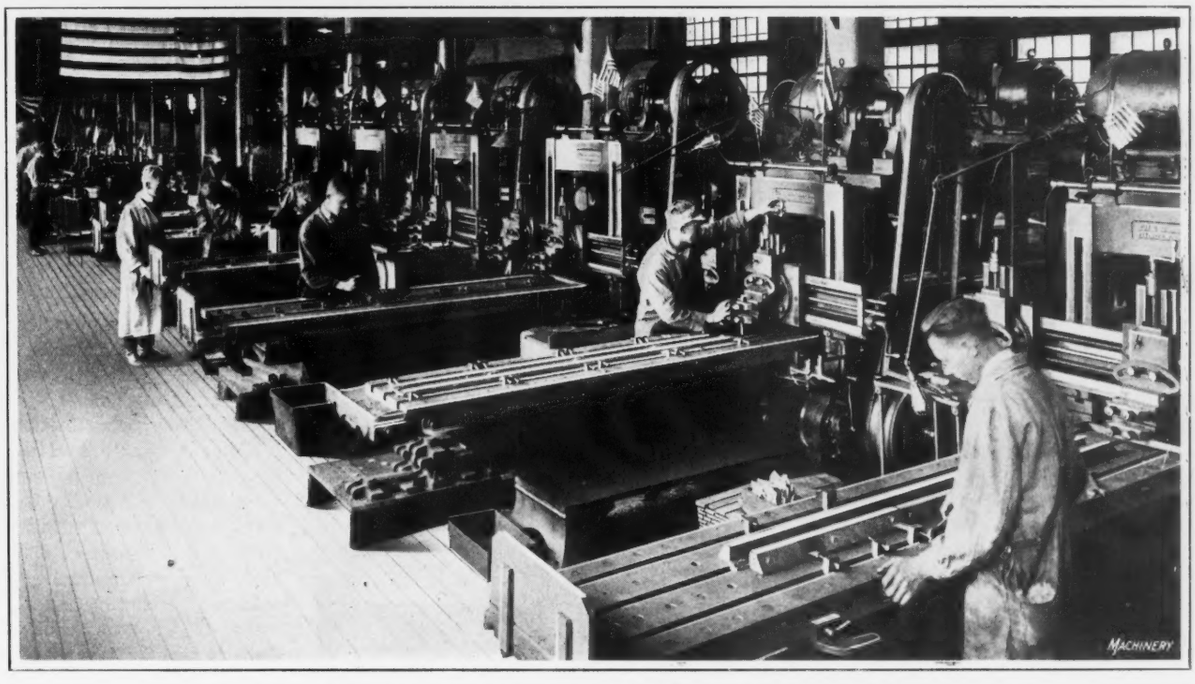


Fig. 1. Apprentices employed on Regular Production Work in the Planer Department

Fig. 2. Apprentices at Work in the Turret Lathe Department

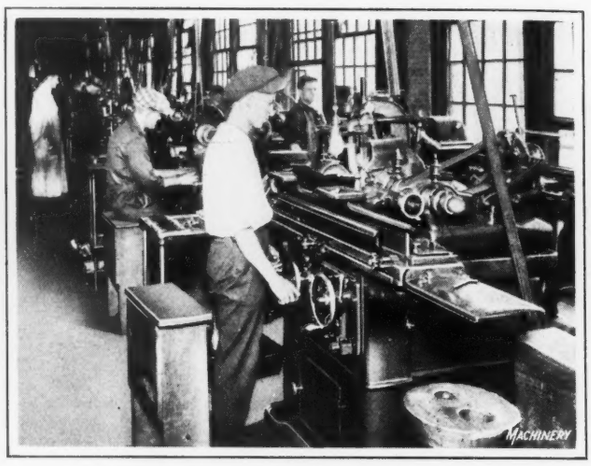


Fig. 3. Boys being trained in the Grinding Department

development, and his training will prove of benefit to other shops rather than to the one in which he was trained. Even if this were true, the objection would hardly be valid, because if a sufficient number of plants maintained apprenticeship systems, the interchange of trained men would promote mechanical progress, rather than otherwise. Even when trained mechanics go into lines of work where no apprenticeships are maintained, as, for example, when men trained in machine tool shops go into automobile plants, their training is not altogether lost to the machine tool industry. The highly developed state of the automobile plants, for example, is largely due to the training that many of the leaders in this field have had in machine tool shops, and because of this training, they have been able to place the automobile industry on a productive plane, so that it has become one of the most important purchasers of machine tool equipment. Whatever promotes mechanical ability in any line, promotes the interests of the machine-building industries as a whole.

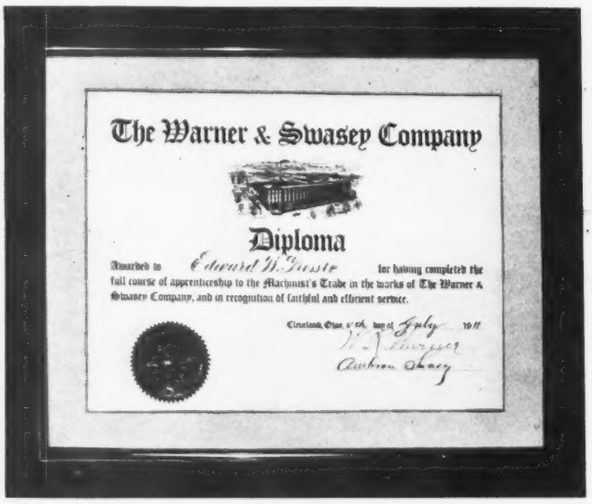
The experience of the Warner & Swasey Co., however, has proved that it is possible to retain a large percentage of the apprentices trained, and the system is regarded of great importance in the development and maintenance of a well-trained organization. The graduate apprentices have had a training that peculiarly fits them for higher positions in the organization, and this is recognized as a basic principle in determining the extent of the course. At present many important positions in this company's shops are held by its graduate apprentices. As a matter of fact, it is most remarkable that practically all the important mechanical positions have been recruited from the young men trained within the shop. Thus, for example, the works engineer, superintendent, assistant superintendent, production engineer, foreman of the drafting-room, and employment manager, as well as several district sales managers, many foremen, inspectors, demonstrators, toolmakers, and machinists are former apprentices. Many graduate apprentices also hold important positions in other plants, and several have established themselves in business and achieved notable success.

Developing the Apprenticeship to Meet Modern Needs

In 1911 an important and, in those days, a radical addition was made to the training provided up to that time. In addition to the shop training, it was decided to give the apprentices classroom instruction at the plant on the company's time, and to include in the instruction such subjects as would make the boys not only better machinists but also better citizens. Since the inauguration of this school, it has been found to meet all the expectations of its founders, and by continuous modifications and improvements a high level of instruction has been reached. The training has developed into what might be called "Junior Engineering."

In order to enter upon an apprenticeship, all the boys are required to have a school training at least equivalent to the eighth grade in the Cleveland schools. As a matter of fact, many of the boys have finished high school when they start their apprenticeship, and most of them have had one or two years of high-school training. Boys between sixteen and twenty years of age are eligible to enter the course.

The boy must apply in person to the employment manager, who frequently requests him to return for further examination. If his application is considered favorably, he will later be notified to begin work, and in order that his fitness for the machinist's trade may be thoroughly judged, the first 1250 hours, or approximately six months of his service, are considered as a trial term, which may be terminated at any time during this period if it is found that he is not qualified to do the work. During this trial period, a report of the applicant's progress is made to the employment manager on the first day of each month. If at the expiration of the trial term the applicant is found to be satisfactory, he is engaged as a regular apprentice, and he and his parents or guardian sign a regular apprenticeship agreement.


The Warner & Swasey Company

Diploma

Awarded to Edward B. Jessie for having completed the full course of apprenticeship to the Machinist's Trade in the works of The Warner & Swasey Company, and in recognition of faithful and efficient service.

Cleveland, Ohio, U.S.A., this 31st day of July 1911

Fig. 4. The Diploma awarded upon Completion of the Apprenticeship

The Shop Training Schedule

The apprenticeship covers a period of four years, including the six-months' trial term, during which time the apprentice receives training in the operation of practically all types of standard machine tools. His time is apportioned approximately as follows: Drilling department, 3 months; milling department, 6 months; planer and shaper department, 6 months; grinding department, 3 months; jobbing work, 4 months; turret lathe work, 6 months; engine lathe

work, 6 months; small tool department, 3 months; assembly work, 4 months; fitting, 4 months; and tool-room work, from 6 to 12 months. The length of time in each department is adjusted, according to the aptitude shown by the boy, so that he will have an opportunity to master all classes of work in his four-year apprenticeship. If a boy shows particular aptitude in design or drafting, his schedule is so arranged as to include some time in the drafting department, and also in the sales engineering department, in which he is assigned work on estimating and tool-designing.

In general, the apprentice follows the regular schedule, but in cases of exceptional ability and application to work he advances more rapidly and gains the advantage of larger variety of work and opportunity for wider experience. All transfers from one department to another are planned ahead, and notices are sent to the foremen in the respective departments several days in advance, so that they may have ample time to plan the work for the apprentices. A simple routing board indicates each apprentice's location in the shop, and also the time that he has spent in the various departments.

Instruction in Shop Work

The apprentice receives instruction in shop work from two different sources—from the foreman or assistant foreman in the department where he is working, and from the apprentice shop instructor. The foreman or his assistant starts the boy to work by assigning him a job, providing him with proper tools, and making the correct set-up for him; from time to time he checks up his work to prevent mistakes. Subsequently the foreman also gives the boy general instruction, as his time permits. Naturally, a great deal of information is obtained from the older experienced workmen, who in a plant where a regular apprenticeship is maintained are generally willing and eager to aid the apprentices.

The apprentice shop instructor supplements the instructions given by the foreman, whose time must be devoted principally to obtaining production from his entire department. Excellent results have been obtained by thus supplementing the work of the foreman. The apprenticeship instructor, who is himself a graduate apprentice of the course, with considerable subsequent experience, goes into every department where apprentices are working, inspects their work, demonstrates how the job ought to be done, cooperates with the foreman in instructing them, encourages apprentices who seem discouraged, and collects information that tends to better the system of apprenticeship training. Every apprentice in the entire shop is visited in this way and receives supplementary instruction at frequent intervals.

The shop instructor, in addition to giving individual instruction as mentioned, also teaches shop practice and related subjects in the apprentice school. This arrangement makes possible effective cooperation between the shop and school work, because it is handled by a man who has both the shop and the school viewpoint.

The Work of the Apprentice School

The apprentice school work is conducted in a separate department provided with typical industrial school equipment. Each boy spends four hours a week in the school, divided into two periods of two hours each. The classes are held during working hours, and the apprentice receives his regular rate of pay while in school. The instructors give their entire time to teaching and preparing outlines and notes for use in their work. At present, two men are constantly employed in this work. As far as practicable, the classroom work is guided by notes especially prepared for use in the apprentice school, describing operations performed in the shop, which are adapted to the abilities and requirements of the students. The subject matter is generally so selected as to supplement the practical shop work. Briefly outlined, the course of study in the classroom covers the following subjects:

First year: Shop tools and machines; drafting-room practice; shop mathematics; shop description; shop spelling.

APPRENTICE WORK RECORD

NAME..... NO.....

TERM COMMENCED.....

MONTH	SCHOOL WORK				SHOP WORK						
	ATTENDANCE	DISPOSITION	GRADE	INSTRUCTOR	DAYS ABSENT	TIMES TARDY	SPOILED WORK	WORKMANSHIP	SPEED	CONDUCT	FOREMAN

Fig. 5. Part of the Monthly Form used for keeping the Complete Record of the School and Shop Work of the Apprentice

Second year: Shop practice; free-hand drawing; practical algebra; practical geometry; shop English.

Third year: Mechanics; heat; trigonometry; problems in detail drawing; estimating.

Fourth year: Strength of materials; properties of materials; metallography; machine design; and shop electricity.

Drawing, mathematics, and some form of shop mechanics form the principal part of the course of study, while instruction in such subjects as heat, electricity, and strength and properties of materials are largely given in the form of brief talks by the instructor.

The material used for study and discussion is almost exclusively derived from the shop itself. All the drawing is based on the standard practice of the shop drafting-room. The apprentice works in the drafting class upon the same kind of drawings that come to him with his jobs in the shop. Owing to the method of instruction, it is practically unnecessary to conduct any classroom work in blueprint reading.

Arrangement of the Classes

In order to so arrange the work that it will not be too difficult for some and too simple for others, it has been found necessary to divide the apprentices into groups according to their previous school training and the progress that they make. If the apprentice school work repeats too much of what has been covered by the boy in his public school work, he will naturally lose interest, whereas his

interest is augmented when he finds that he is constantly forging ahead. Many of the difficulties that arise due to the differences in previous training are overcome by attending personally to the individual needs of each apprentice, and recognizing his ability to progress independently. In this way it has been found possible to so conduct the classes as to meet the needs of apprentices who have had only a grammar school education and as well as of those who have had from one to four years of high-school training.

The Progress Reports

Each department head, both in the shop and in the classroom, prepares a monthly report on each individual apprentice under his direction. From these reports an accurate record is kept of each boy's work, including his comparative skill, application to work, attendance, punctuality, conduct, and amount of work spoiled. The form on which this record is kept is shown in Fig. 5. From the combined reports of those under whose direction the apprentice is working, the employment manager submits every three months a report to the parents or guardian, such as shown in Fig. 6; these reports must be signed by the parent and returned to the company. If necessary, the parents are requested to visit the employment office for further discussion.

Compensation of Apprentices

The rate of wages per hour for periods of about six months changes from time to time in accordance with the general scale of wages in the industry. The minimum at present is 25 cents per hour, rising from this to a maximum, in the last six months, equal to the journeyman's wage which the apprentice will receive upon graduation. In addition to his regular wages, each apprentice, upon having satisfactorily completed the full four-year course, receives a gratuity of $100, a graduate apprentice pin, and a certificate of apprenticeship.

QUARTERLY APPRENTICE REPORT

REPORT FOR QUARTER ENDED _____

NAME OF APPRENTICE _____

SHOP RECORD

MONTHS	DAYS ABSENT	TIMES TARDY	SPOILED WORK	WORKMANSHIP	DEPARTMENT AND MACHINE	SPEED	CONDUCT
TOTAL							

SCHOOL RECORD

MONTHS	ATTENDANCE	DISPOSITION	GRADES	

REMARKS

_____
PARENT OR GUARDIAN'S SIGNATURE

THE WARNER & SWASEY CO.

PER _____
EMPLOYMENT SUPERVISOR

Fig. 6. The Quarterly Apprentice Report sent to the Parent or Guardian

Apprenticeship Activities Outside of Shop and Classroom

From time to time groups of apprentices are taken on visits to other shops and to places of industrial interest in the community. In most instances, metal-working plants are selected for such visits, so that the apprentice may have an opportunity to observe the methods, practices, and plant lay-outs employed in other shops.

An apprentice club has been instituted so that the boys may become acquainted with one another. This club meets regularly once a month, except during the summer, and outside speakers are usually present to address the club. The officers and other executives of the company also frequently speak to the boys. The apprentices themselves often give talks on mechanical or related subjects, the program usually being followed by refreshments and some form of entertainment.

There is a table in the apprentice school on which current trade journals and popular magazines are kept, and the factory office operates a branch of the Cleveland public library, through which the apprentices may draw books on any subject desired. Athletics are given especial attention, and the annual outing of the apprentice club is an event eagerly looked forward to by the boys. On this occasion the executives of the company are present, and transportation by automobile is provided by them.

The Results of the Training Courses

As already mentioned, many of the executives of the Warner & Swasey Co. have themselves been apprentices in the shop. The company recently canvassed the entire list of graduate apprentices who have passed through the course during a period of approximately forty years. It was found that the majority of these men held positions well above the rank of ordinary journeyman—in fact, most of them were foremen, superintendents, or executives in machine-building plants. This would seem to prove conclusively that this training increases the ability and capacity of the men taking the courses. The discipline in careful and accurate work, and the actual knowledge gained during the four years' apprenticeship training are shown to be of lasting benefit. So much for the advantages to the man himself.

As already mentioned, the company providing the training considers that its organization is strengthened because of its apprentice system. The productive capacity of the apprentice is satisfactory, and many of the apprentices later come to occupy important positions in the shop organization.

The success obtained by this company during so long a period of years points conclusively to the fact that a properly maintained apprenticeship system is an asset to the individual plant that keeps it continuously in operation. It proves that it is possible to interest young men in obtaining a thorough mechanical training. It shows that what is needed in the metal-working industries is a definite purpose to train future mechanics, and that if the will and purpose are present, results can be obtained that will prove an asset rather than an expense.

* * *

In an analysis of the machine tool industry by Wallace T. Montague, sales manager of the Grinding Machine Division of the Norton Co., Worcester, Mass., based upon compilations for 1921 published by the Bureau of Census, it is pointed out that the ten leading machine tool producing cities of the United States, in the order of the value of the product, are: Cincinnati, Providence, New York, Cleveland, Philadelphia, Rochester, Hartford, Toledo, Worcester, and Detroit. The prominent position of New York as a machine tool producing center will probably be a surprise to many. It is possible that in this figure are included machine tools that are not actually produced in New York, but that are built elsewhere by the large machine tool concerns that have their headquarters in New York. In an article published in June, 1921, MACHINERY, based on the number of men actually employed in machine tool shops in different cities in 1918, New York took the sixth place. The most important classes of machine tools, in order of the value of the annual output, are presses, lathes, portable tools, milling machines, grinding machines, drilling machines, boring machines, screw machines, gear-cutting machines, and planers.

Equipping the Shaper for Production Work

By DONALD A. HAMPSON

THE possibilities of the shaper as a manufacturing tool are not generally realized or taken advantage of by the engineering and planning force, although the shaper is often set up for a simple job of metal-cutting and not changed from one month to the next. Usually this work consists of shaping pieces that are held by clamps or in the shaper vise, the cuts being taken with standard tools held in the regular tool-post. For this kind of work measurements must be made and the tools set the same as for the ordinary run of shaper work. There are a limited number of shops that make use of dual fixtures, one of which is loaded while the other holds the piece or pieces being machined. Special tool-heads or forming tools may also be used. This brings the job under the heading of "production work."

Name-stamping Attachment for Shaper

The shaper work dealt with in this article is not strictly metal-cutting, as may be inferred by reference to the part shown at *A*, Fig. 1. This part is turned to shape on an automatic screw machine from ⅝-inch brass rod, after which the words "Warner" and "Patents" are stamped on the head end, as shown, in the shaper. The latter operation naturally comes within the scope of the marking machine, or it could be done on a press equipped with a dial fixture or some type of feed that would bring the pieces under the stamp or punch without requiring the operator to place his hand or fingers within the danger zone. Both of these methods were given a fair trial and found to be satisfactory only with respect to quality, the output being low because of apparently insignificant handling delays.

When the shaper was employed for this operation the quality of the work remained high, that is, an even impression and a correct location of the words were obtained, and for the first time the output jumped ahead of that of the automatic screw machine employed to form and cut off the parts from bar stock. A production of from 1400 to 1600 stamped pieces per hour was obtained. The shaper thus became the pacemaker, as it did not depend upon the skill of the operator. The hand stamp *B*, which is shown gripped in the holder *C*, was the one previously used in the press to stamp the words on the part *A*. The holder *C* has riveted to it a yoke *D*, which is provided with a set-screw *E* for adjusting and backing up the stamp. A steel angle *F* is attached to one side of the holder. This angle carries the cam bar *G*, which is moved back and forth at each stroke of the shaper; in other words, the cam bar *G* moves forward and returns with the stamp *B*. The holder *C* is, of course, held in the shaper toolpost, where it can be adjusted to line up with the corresponding parts of the fixture that are clamped to the table of the shaper.

The base casting *H* of the fixture is bolted to the shaper table, where it is locked and held in accurate alignment by the tongue *I*. The base is machined to receive the two sliding pieces *G* and *J*. Part *G* has a cam-shaped end *b* which causes slide *J* to travel back and forth at right angles to the direction in which the shaper ram and holder *C* travel. It will be noted that the cam bar *G* fits into the

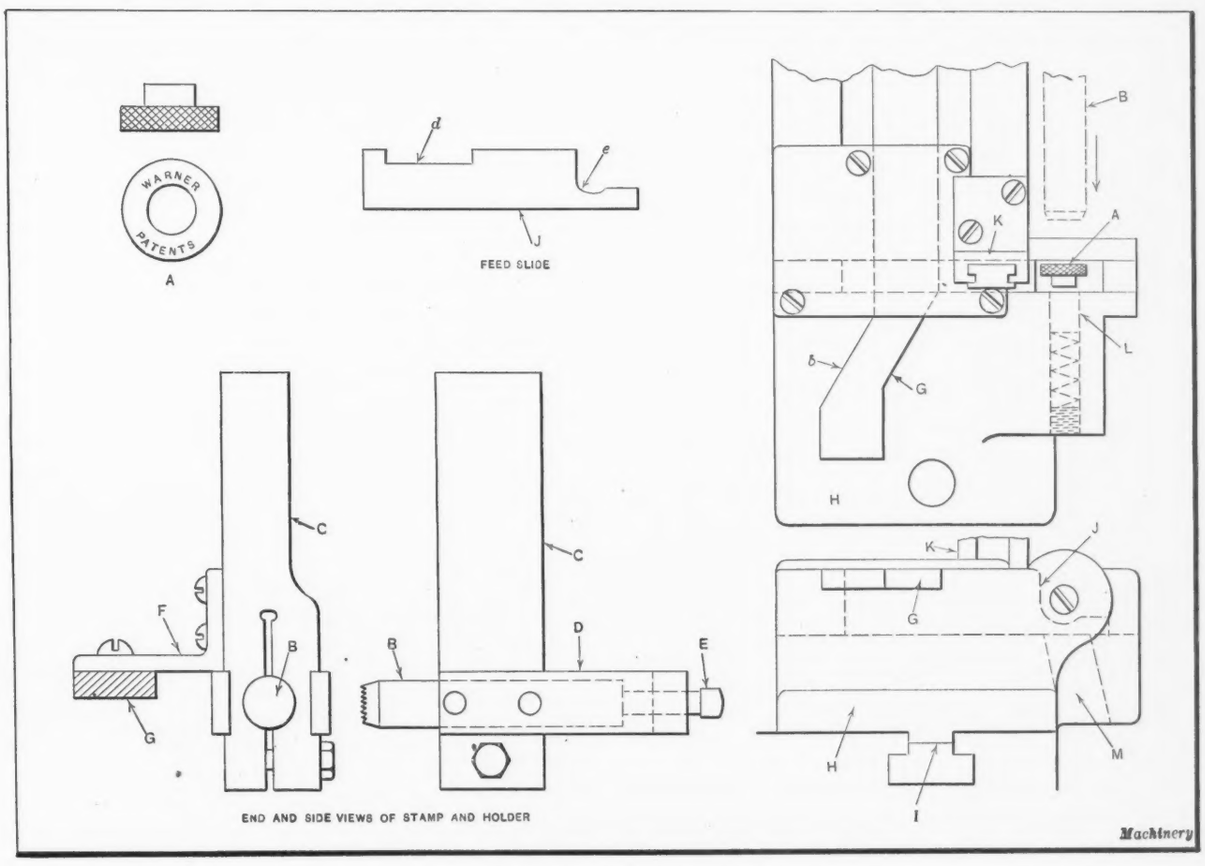


Fig. 1. Chute-fed Stamping Attachment for Shaper

rectangular slot indicated at *d* in the view at the top of Fig. 1. The rounded notch at *e* in slide *J* receives the brass heads *A* from the feeding chute *K* shown in the view at the right-hand side.

When the slide *J* has reached its extreme right-hand position, as shown in these views, the stamp shown in dotted lines in the upper view has reached a position quite near the work, so that it must be carried forward only a short distance by the shaper ram to stamp the words on the work. The long dwell of the cam slide *G* allows the stamp to continue its advance after slide *G* has reached its extreme right-hand position.

As the hub of piece *A* is not strong enough to stand much pressure, a recess is cut in the body *H*, into which the hub is carried, so that the impression is made with the work backed up by a solid piece of metal. The hole into which the hub recedes is provided with a spring-actuated plunger *L*, which ejects the work on the back stroke of the ram so that it falls through the slot *M* into a receiving box. The magazine or chute *K* is located in such a position that the lower end of the piece is drawn into the rounded notch *e* of slide *J*, when the latter has reached its extreme left-hand position on the back stroke of the ram. The chute *K* stands upright and in full view of the operator, who simply drops the pieces to be stamped into the open upper end.

Fixture for Cutting Evenly Spaced Lines

At *A*, Fig. 3, is shown a piece of work that is required to have a series of evenly spaced lines, such as those shown at *a*, scribed or cut on its upper face. These lines must be accurately spaced about ⅛ inch apart, and cannot be rolled in on account of the burr thrown up by the rolls. In order to enable these lines to be cut quickly and accurately on the shaper, a fixture such as shown in Fig. 3 was made. A channel *B* was cut in the top of casting *C*, of the same width as the piece to be graduated plus a clearance of about 0.010 inch. Over this slot was placed a block *D* which carries the forming cutter *E*. This cutter is made like a circular forming tool for a screw machine with rings turned to the required ⅛-inch spacing. The edges of these rings are notched in to provide suitable cutting points for scribing lines *a* on the part shown at *A*.

The cutting of the lines to the correct depth is provided for by the proper location or assembling of the cutter *E* on block *D*. The cutter can be sharpened by grinding the notched faces of the rings. The nut on bolt *F* is tightened just enough to hold cutter *E* in place, but does not prevent the cutter from turning if a piece of work becomes wedged in it or is a little too thick. The blocks are pushed in front of the channel *B* against the projecting bar *G* by the operator, from which position they are carried forward by a rod held in the toolpost of the ram. The piece of work nearest the cutter *E* is thus forced through the fixture and out at the opening *H*. A flat spring *J*, placed in front of the cutter, presses the work down firmly so that it will not buckle or be dislocated when it is pushed under the cutter.

Knurling Operations

Two knurling jobs that would ordinarily be done in a lathe but that were successfully handled on the shaper are described in the following: One piece was a ⅜- by 4-inch bolt having a ⅝-inch round head with a deep straight knurl. This piece was required in lots of 500 to 1000. For certain reasons, the knurling could not be done at the time the screws were machined. The knurling dies were made from two flat pieces of carbon steel which were serrated in accordance with the pitch desired. One of these dies was fastened to the shaper table, and the other secured to a bar held in the toolpost of the ram. The plan was to roll in the knurl the same as threads are rolled, but in this case, it required several strokes of the ram to force the metal to flow upward and form sharp edges.

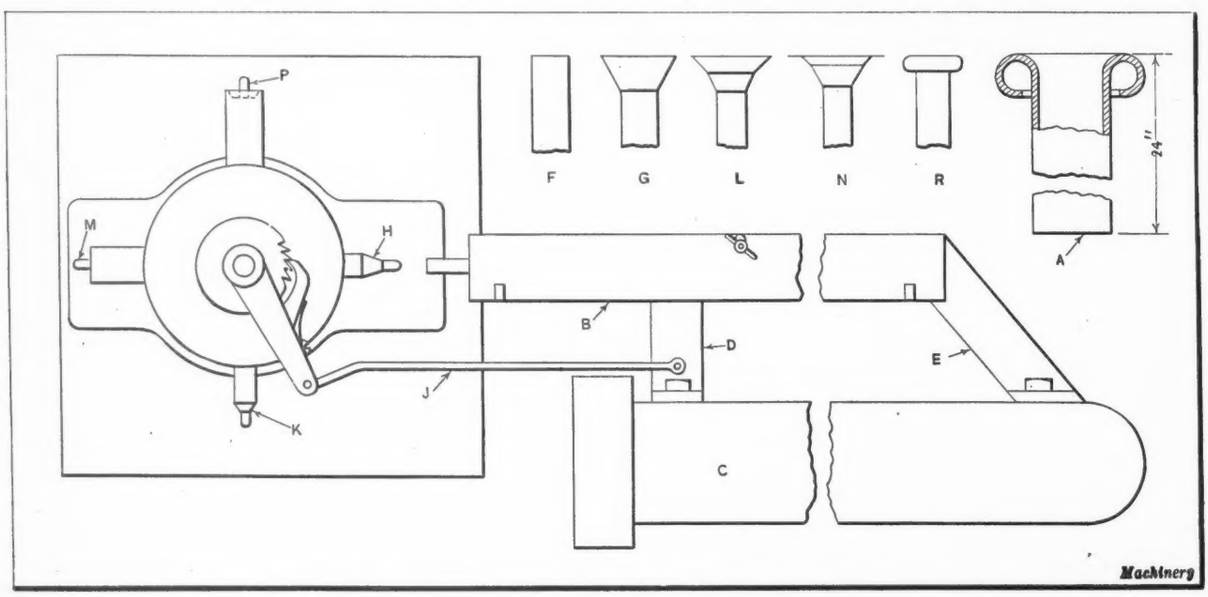


Fig. 2. Indexing Tool-holder used in curling Ends of Tubing

The shaper was run at a slow speed, the upper die being held at a predetermined height. It was necessary, of course, to fasten the clapper of the shaper head down and adjust the stroke of the ram to the equivalent of the circumference of the work, so that the serrated blocks would not overlap or pass over the same surface more than once.

The other knurling job referred to consisted of straight knurling on ⅛-inch rods, 18 inches long, for the purpose of producing a press fit for some collars. A rod of this size is, of course, too small to be knurled in a lathe in the usual manner. When a press fit is provided for parts of this kind, it is customary to nick two sides of the rod with a chisel, but in the present case a better bearing than could be obtained in this way was desired. The straight knurling proved satisfactory, as it gave a uniform rise or swelling of the metal on all sides of the rod. Two dies similar to those used for the knurling operation just described were employed in this case. A single pass of the work between the dies produced the desired results. The work was done more quickly by this method than by any previously tried, and it was possible to employ unskilled labor for the job.

Curling the Ends of Brass Tubing

The work of curling the end of the tube, as shown in the enlarged view at *A*, Fig. 2, is of more than usual interest. The tool equipment shown in this illustration was

employed on a shaper with success, after several discouraging attempts had been made to perform the curling operation by other methods. A sufficient quantity of brass tubing had been purchased to make up about 20,000 pieces with the ends curled up. The order was placed with the understanding that the ends of the tubing were to be curled without splitting.

The tubing was held in a clamping device *B*, which was secured to the shaper ram *C* by straps *D* and *E*. The cover of clamp *B* is hinged to permit loading, and is provided with a stop on the inside (not shown) which takes the thrust of the tube and locates it so that just the right length projects from the left-hand end. Only four strokes of the ram are required to complete the curling operation. On the first stroke of the ram, the end of the tube shown at *F* is spread or formed to the shape shown at *G* by the punch *H*, held in the indexing fixture. On the return stroke, the indexing mechanism or ratchet, operated by rod *J*, indexes the punch *K* into position, so that on the next forward stroke of the ram, it will form the tubing to the shape indicated at *L*.

After this operation, the punch-holding turret is again indexed by the return stroke of the ram, so that on the succeeding stroke, punch *M* forms the end of the tubing to the shape indicated at *N*. The fourth tool *P* is next indexed into position in the same manner, and completes the curling of the tube to the shape indicated at *A* and *R*. The number of tubes that were split, in using this equipment, was comparatively small. Each tube was put through an annealing process before the curling operation. While similar results could, no doubt, have been obtained by using a punch press, the equipment described proved simple to construct and was convenient to operate.

Performing Simple Bending Operations on the Shaper

A simple bending operation on the part *A*, Fig. 4, was performed with the inexpensive equipment shown diagrammatically in the view at the right-hand side of this illustration. The pieces *A* are made up in lots of 10,000, from cold-drawn square bars, and after the milling operations, they are required to have the tongues bent, as indicated by the dotted lines at *B*. For the bending operation, it was not necessary to remove the regular vise from the shaper. A piece of machine steel, machined to fit the groove in block *A*, was secured between the vise jaws. As the

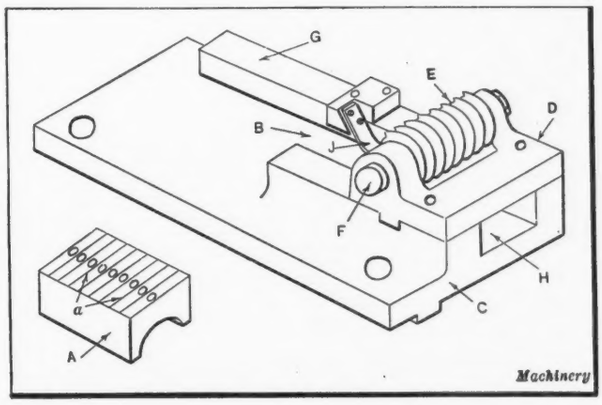


Fig. 3. Line-scribing Shaper Attachment

parts were made accurately to size, they were all a good fit in the tool-steel piece *D*, so that it was not necessary to clamp them.

From the foregoing the adaptability of the shaper as a manufacturing machine should be apparent. Its possibilities are so great that a plant having work that can be performed by a reciprocating movement cannot afford to overlook them. Adjustments can be made instantly on the shaper, the equivalent of which on the punch press is a tedious alteration of punch-and-die parts. For this reason, the designer may use tentative sizes and disregard minor details until trial parts are produced, thus avoiding the necessity for making expensive tools for the production of pieces whose action cannot be determined in advance. Designs that call for limited quantities may be put through at a reasonable expense, and hurry orders and "specials"

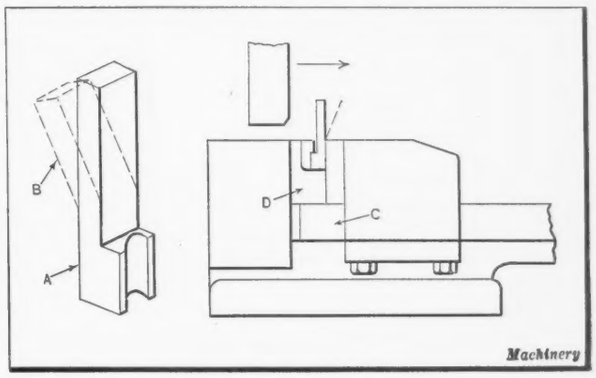


Fig. 4. Shaper Set-up for Bending Operation

can be run off in quantities that would not warrant the investment in tool equipment required for a press.

Of course the manufacturing that can be done on the shaper is in the nature of press work—work that requires a straight-line movement that may be utilized for cutting or forming. Since there is no flywheel effect, the amount of work that can be done per stroke is less than on a punch press. But the universal features of shaper construction more than make up for lack of power; because of the adjustments that can be made, it is possible to get along with simple tools, and small-quantity jobs can be run off that would be unprofitable to produce in the punch press.

* * *

HELPING THE EXPORTER

The Bureau of Foreign and Domestic Commerce, Washington, D. C., has brought out a booklet called "Helping the Exporter," which explains the service rendered by the bureau to manufacturers who are endeavoring to obtain export trade. It contains a brief account of the organization and service rendered by the bureau, a review of the publications that it issues, and a summary of the service rendered by its different departments. The bureau's organization is divided into three groups or sections, as follows:

1. The foreign field force—consisting of commercial attachés, trade commissioners, and their staffs—which collects timely data on trade problems and market conditions and collaborates with the Consular Service in covering every trade center of the world.

2. The Washington staff, which directs the field force, collates its findings, and transmits them to the trade by letter, radio, wire, special mimeographed circulars, the department's weekly periodical *Commerce Reports*, numerous bulletins, and through press "releases" to 600 or more trade papers which, by special arrangements with the bureau, carry a regular foreign-trade section or department for that purpose. This staff enjoys the active collaboration and counsel of more than 70 trade committees, representing about 155,000 member firms. It consists of commodity and technical experts, including specialists in foreign tariffs and commercial laws, statistics, financial matters, transportation, and in the general economic conditions peculiar to each of the important commercial areas of the world.

3. The district and cooperative offices, which are maintained as "service stations" in 35 leading trade centers of the United States, expressly for the purpose of saving time in transmitting commercial intelligence.

Any manufacturer who has found difficulties in entering the export field would do well to obtain a copy of this booklet.

MULTIPLE FIXTURE WITH UNUSUAL EQUALIZING MEANS

When it is necessary to hold a number of pieces in a fixture at the same time for an operation that must be performed within close limits, it is often difficult to locate each piece accurately relative to the cutter and to every other piece. In planning the tooling for the part shown in Fig. 1, which is a bolt used in a locking device for automobile steering wheels, the engineering department of the Eastern Tube & Tool Co., Inc., Brooklyn, N. Y., decided that the operations of milling slot *A* and fillet *B* could be most economically performed by the use of a multiple fixture. The plus and minus limits of 0.002 inch specified for the dimension from the top of the teeth at the left-hand end of the bolt to the left-hand end of the slot, necessitated a fixture in which accurate location of the pieces would be assured. The ingenious fixture that was finally designed for holding twelve bolts during these two operations is illustrated in Figs. 2 and 3.

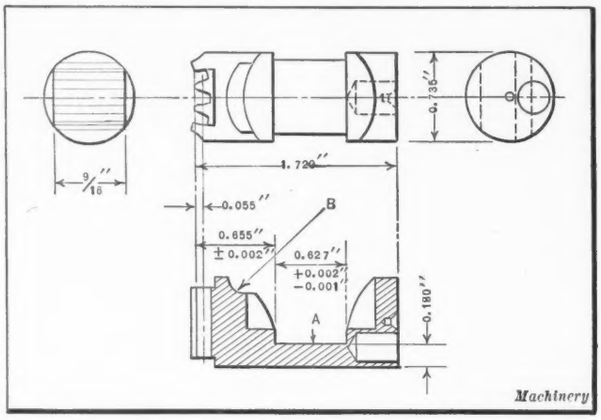


Fig. 1. Bolt used in a Lock for Automobile Steering Wheels

Beeswax or paraffin is used to exert an equalized pressure on each bolt, and thus insure its accurate location in the fixture. From Fig. 1 it will be seen that there are four 18-pitch teeth cut on one end of the bolt, and that a center is drilled in the opposite end. Referring next to Fig. 2, it will be noticed that the central space between the teeth of each bolt is held against a tooth *C* of a block at the middle of the fixture, and that the opposite end of the piece is held in place by a center *D*. The bottom of the bolts rests flat on the top of the block *G*, the height of the centers above this surface being equal, of course, to one-half the diameter of the bolt.

On each side of the fixture there is an arm *E*, which has a hole *F* drilled horizontally almost its entire length. The outer ends of centers *D* project into these holes, which are filled with beeswax. The beeswax is poured into the holes while melted, and is prevented from leaking out by means of threaded plugs. It remains in a plastic condition after cooling. In loading the fixture, the left-hand arm *E* is pushed slightly to the left to permit laying six pieces into engagement with teeth *C*, the centers being opposite centers *D*. Then the arm is pulled in to bring centers *D* into contact with the pieces. This movement at the same time pushes the right-hand arm *E* out. After six pieces have been laid in the right-hand side of the fixture, nut *H* is tightened by means of a wrench, bringing both arms *E* toward each other sufficiently to cause the plastic beeswax in holes *F* to exert an equal pressure against each center *D* and thus locate every piece similarly against teeth *C*.

Spring *J* at the center of the fixture makes the two arms *E* act in unison, both when loading the fixture and when tightening nut *H*. There are also adjusting bolts at each end of the fixture at the bottom, by means of which the top of arms *E* can be tilted a sufficient amount so that when nut *H* is tightened, the centers *D* will push the bolts downward on the top surface of block *G*. The operation of milling fillet *B*, Fig. 1, as illustrated in Fig. 3, is performed on a Pratt & Whitney automatic milling machine. The same machine and set-up, with the exception of the milling cutters, is also employed for milling slot *A*, Fig. 1. In milling the fillet, an average production of 150 bolts per hour is attained, and in milling the slot the production is 110 bolts per hour.

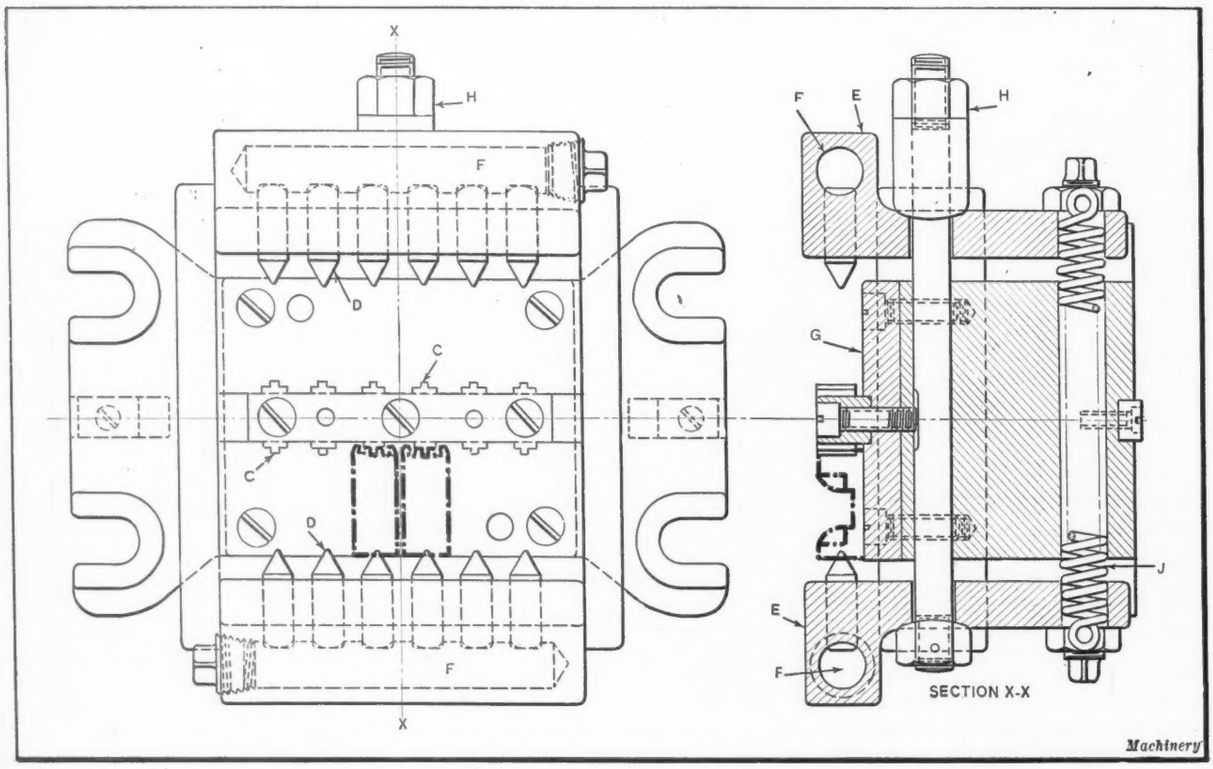


Fig. 2. Multiple Milling Fixture used to hold Twelve Pieces of Work like that shown in Fig. 1

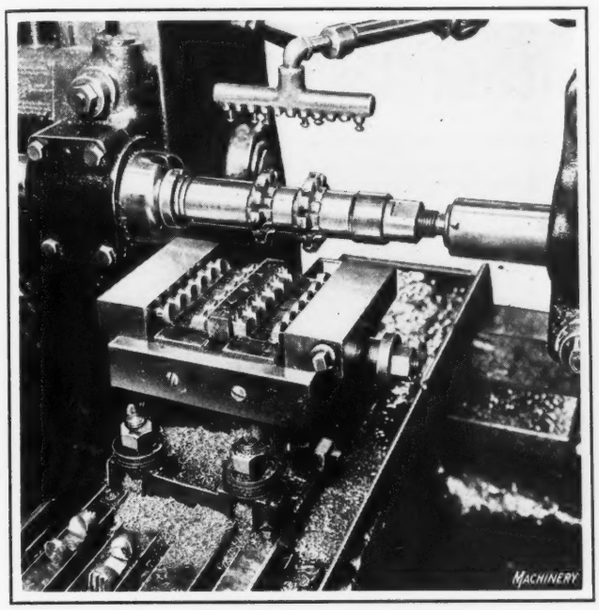


Fig. 3. Multiple Milling Fixture, Assembly Views of which are shown in Fig. 2

PRACTICAL RESULTS FROM RESEARCH

The possibilities of improving the quality of the product and the service to customers as a result of engineering research work, has been exemplified in the case of steel castings. In 1920, five independent manufacturers formed the Electric Steel Founders' Research Group. It was found that the research necessary to improve the methods in a steel foundry would cost more than each individual company could afford to spend, but by uniting, the manufacturers were able to provide for extensive cooperative research work.

The formation of this group of separate and distinct companies to conduct cooperative research is an innovation in American industry. Executives of each plant are free to go into any other plant in the group to learn how certain processes or operations are carried on, and to obtain ideas for application in their own plants. The research work is conducted with a view to determining the causes of inefficiency, and to settle upon the best methods. The results of the work are transmitted to all companies in the group. The cooperative effort is further extended to the buying of new equipment. If a question arises concerning the best type of equipment for a certain purpose, research studies are made at different plants on different kinds of equipment, and the operating efficiency and costs are compared to determine which is the best type of equipment for the work in hand.

Among the researches that have brought practical results are included studies on molding and core sands, heat-treatment of steel castings, prevention of slag in castings, and methods of removing risers and gates from castings. These investigations have aided materially in producing castings that ordinarily would have been considered very difficult or even impossible to make. Complete specifications for steel castings have been adopted, together with a set of inspection standards covering the entire output of each plant.

The research work conducted by these manufacturers has decreased the cost of castings to consumers. It has decreased machining costs and losses due to defects in castings, and has prevented customers from turning to other materials in the belief that certain castings could not be satisfactorily made in steel. The utility of steel castings has been increased and their application broadened, with the result that steel castings are now used for many parts that it would formerly have been necessary to make from other metals.

DRILLING CASTINGS ON A PLANER

By EDWIN HANSALPAKAR

One of the machines built in the shop where the writer is employed as foreman has a bed weighing about 450 pounds. As the casting for this bed is a little too heavy to be readily handled or relocated by one man on the table of a drilling machine, the writer rigged up a portable electric drill on the tool-holder of a planer to handle the job. With this arrangement, the drill could be located in any desired position over the work by moving the planer table by means of a handwheel attached to the drive shaft and by using the hand cross-feed. The portable drill was attached to a simple knee casting bolted to the tool-holder. The regular hand down-feed of the planer tool-holder was used to feed the drill into the work. Care was, of course, taken to see that both driving belts on the planer were removed from the pulleys before the machine was set up for drilling operations.

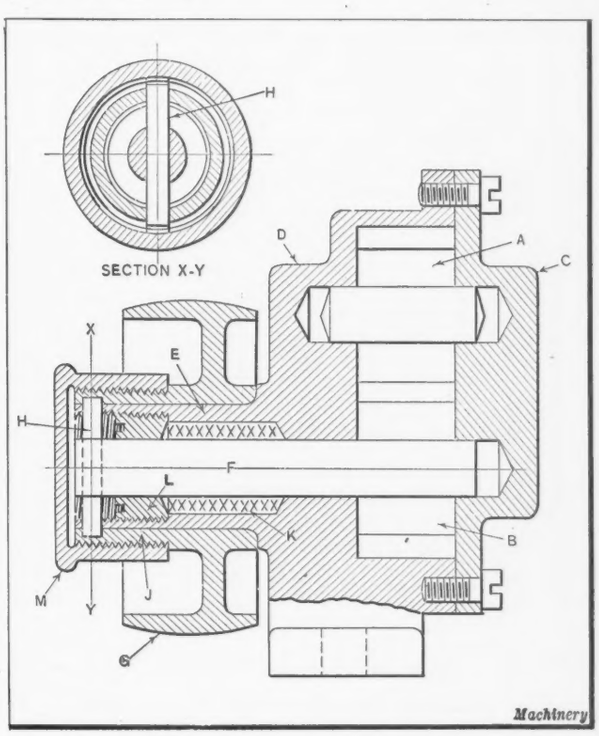
* * *

ROTARY GEAR OIL-PUMP

By TH. R. WAGNER

In the accompanying illustration is shown a cross-sectional view of a rotary gear oil-pump designed for use on turret lathes, milling machines, and other machine tools. The main pump gears, *A* and *B*, are of the usual design, as is also the cover plate *C*. The body casting *D* is designed with a hub or projection at *E* which is machined on the outside to a good running fit in the hole of the hub of the driving pulley *G*. Thus the tension of the driving belt on the pulley is not transferred to the shaft *F*, but is taken by the hub *E* on casting *D*.

The shaft *F* is driven by means of a cross-pin *H*, the ends of which fit into notches cut on the outer end of hub *J*. The cross-pin *H* also serves to keep the pulley from running off the bearing *E*, as shaft *F* is securely fastened to gear *B*. The packing *K* is compressed and held in place by the threaded plug *L*. The cap *M* is filled with vaseline to provide lubrication and also prevent air from leaking into the gear chamber around shaft *F*, which remains a close fit in its bearing for an exceptionally long time owing to the fact that it is not subjected to the pressure exerted by the driving belt.



Method of relieving Gear Pump Shaft of Belt Tension

Mechanisms for Preventing Tap Breakage

By ARTHUR PESTEL

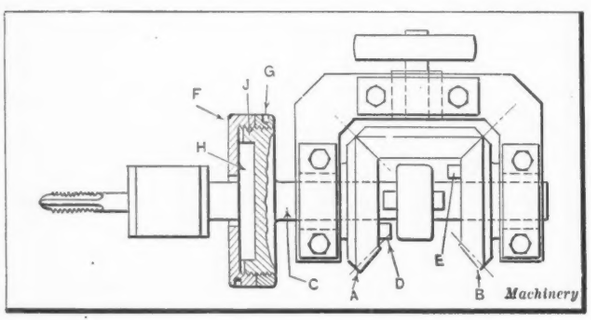


Fig. 1. Pin Clutch and Friction Drive Tapping Device

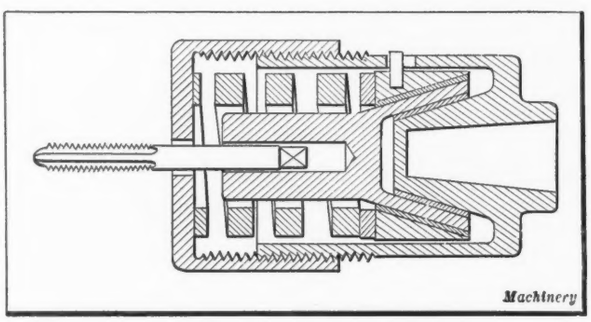


Fig. 2. Spring Tension Friction Driving Clutch

THE various devices commonly called "safety tapping mechanisms" comprise machines and attachments as well as chucks. In this article some of the more important problems involved in designing safety tapping mechanisms will be dealt with, and methods suggested for overcoming some of the difficulties encountered with certain mechanisms that have been developed for this work, especially those intended for use with small sized taps which are more easily broken.

In general, the manufacturer is not so much concerned about the loss of a few taps as he is about the spoilage of the work or the trouble and extra time required to extract the broken tap from the work. Under ordinary conditions, a tap may break when it becomes dull, when chips become wedged under the teeth while the tap is being backed out of the work and when it is not led straight into the work. The latter condition in most cases may be overcome by employing a floating chuck.

Breakage caused by the tap having become dull and also by wedging of the chips, is now being eliminated to some extent by employing safety release mechanisms, which are generally introduced between the tap and the driving elements or members. In the main, these releasing mechanisms have been made with friction devices which are caused to slip if the strain on the tap is excessive. They are usually either connected to the reversing mechanism of the tapping machine, as shown in Fig. 1, or form an integral part of the latter, as in the case of the type shown in Fig. 3.

Types of Friction Releasing Mechanisms

An ordinary form of reversing mechanism with a friction releasing device introduced between the tap holding chuck and the reversing mechanism is shown in Fig. 1. Gears *A* and *B*, which rotate in opposite directions, drive the spindle *C* by means of pins *D* and *E*. Either one of these pins may be engaged so that the spindle will rotate in the desired direction. To the spindle *C* is fastened the friction device, consisting of the disk-shaped friction members *F*, *J*, and *H*. The frictional driving power of the device is adjusted to handle a load somewhat below the load that would cause the tap to break.

The friction members of the tapping mechanism shown in Fig. 3 are not kept under a constant pressure, but the pressure required to obtain the necessary frictional driving force is exerted by the operator of the machine. To a spindle *A* is fastened a frictional member in the form of a disk *B*. This disk is pressed against either one of the two frictional surfaces on gears *C* and *D* which rotate in opposite directions. With this mechanism, the operator determines the amount of pressure that must be exerted on the tap before the spindle will be stopped by the slipping of the friction driving members. Either one of the two types of friction devices just described will be found to be incor-

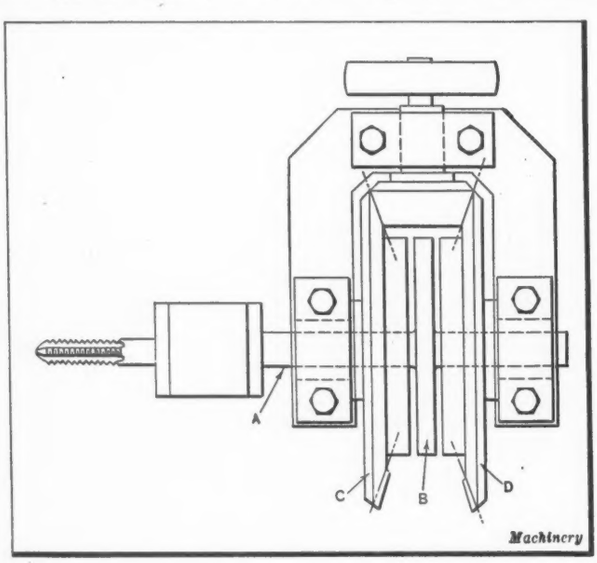


Fig. 3. Friction Clutch Type of Releasing Mechanism for Tapping Operations

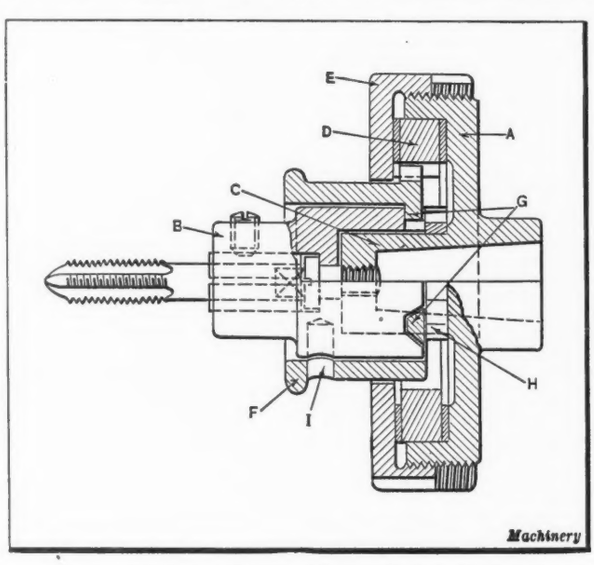


Fig. 4. Releasing Mechanism of Driving Device with Parts in Operating Positions

porated in the safety tapping devices that have appeared on the market.

The difficulty of maintaining a constant coefficient of friction with the type of mechanism shown in Fig. 1, if the tap is overloaded at frequent intervals, is rather an undesirable feature. Since the coefficient of friction varies with the smoothness of the surfaces in contact, and the kind of lubricant, if any, that is used, it is evident that some difficulty will be encountered in constructing a friction safety device that can be depended on to give satisfactory results.

If both friction members are constructed of metal and are held in contact by a constant pressure, it is important that the friction surfaces be kept well lubricated. The lubrication of such devices, however, is quite often neglected by the operator. If only one of the friction surfaces is of metal and the other of fiber or some similar material, the problem of lubrication need be given but little consideration. It is a fact, nevertheless, that frequent adjustment of the friction members is necessary in order to maintain the required driving power if the members are allowed to slip too often.

In order to avoid the constant lessening of the pressure on the friction members which results from wear, the friction device shown in Fig. 1 may be replaced by the one shown in Fig. 2. With this device, the necessity for frequent readjustment is practically eliminated, although if the friction members are allowed to slip too often, the smoothness of the fiber member will be affected so that the frictional resistance will be increased instead of decreased, for the reason that the pressure which keeps the friction members in contact remains the same.

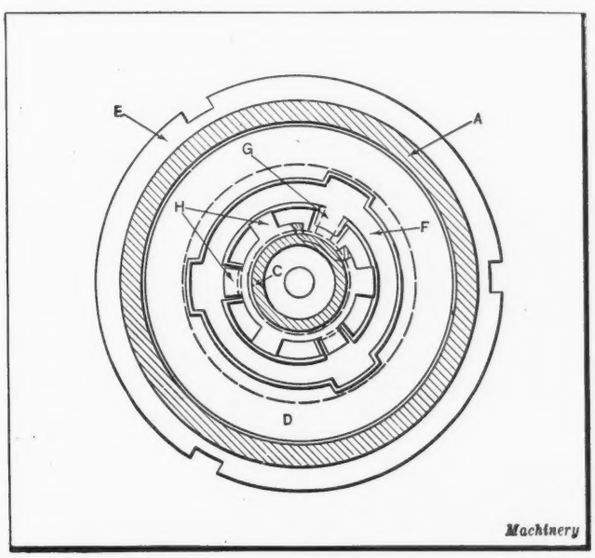


Fig. 5. Plan View of Mechanism shown in Fig. 4

It has already been pointed out that with the mechanism shown in Fig. 3 the determination of the amount of pressure required for the operation of the tap depends entirely on the judgment and skill of the operator. In order to force a dull tap through the work, the operator will naturally exert more pressure, and if he continues to use the tap until it becomes very dull, breakage will usually occur.

Break-pin Releasing Mechanism

Besides the types of friction releasing mechanisms described, there is another practical means of obtaining the safety release. This consists in the use of a so-called "break pin" which may be introduced between the driving and driven member of the tapping machine. If the tap is overloaded, the break pin will be sheared or broken, and the tap-holder thus released from the driving member. The break pin has the desirable feature that its resistance remains constant up to the point at which it is sheared.

Preventing Power Losses in Friction Members

The writer believes that a further improvement in safety releasing mechanisms should be made which would eliminate or lessen the energy wasted when the adjusted friction members rub together after the tap has stopped rotating as a result of being overloaded. This trouble may be overcome to some extent by instructing the operator to reverse the tapping mechanism as quickly as possible when the friction mechanism acts. This will lessen the amount of wear on the friction members and reduce the power losses to a minimum.

If the operation of tapping a hole for a ¼-inch diameter thread is considered, some idea of the wear on the friction surfaces may be obtained. For a ¼-inch tap operating in iron or machine steel, a speed of approximately 450 revolutions per minute is permissible. Now if the tap is dull and the friction device slips, it can safely be assumed that under average conditions the length of time before the operator will notice the slippage and reverse the tapping mechanism will not be less than ½ second. Assuming that the time is only ½ second, we have

$$\frac{450}{60} \times \frac{1}{2} = 3\tfrac{3}{4} \text{ revolutions.}$$

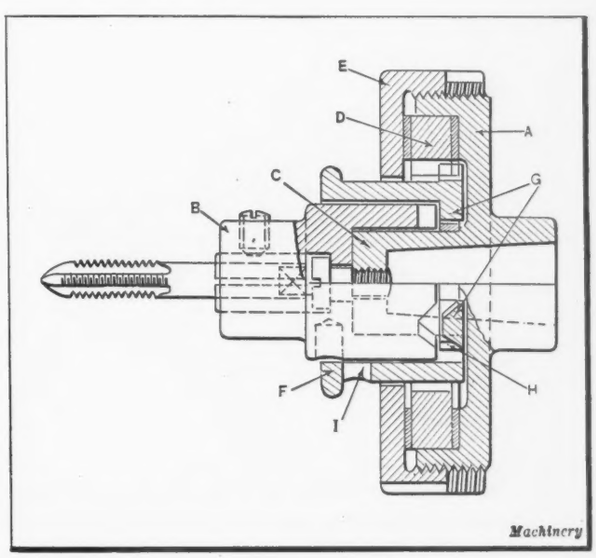


Fig. 6. Mechanism with Driving Members disengaged

A repetition of this process a great number of times during the day naturally results in considerable wear on the friction members.

The problem of lessening the wear on the friction surfaces consists, therefore, in finding some means of reducing the number of idle revolutions. This may be done by providing some means of automatically releasing the driven from the driving member after the friction members have slipped only a fraction of a turn. The disengaged members may then be reset by the operator. When the driving and driven members require releasing too frequently, this will indicate to the operator that the tap is dull and should be exchanged for a sharpened one.

Friction Mechanism with Positive Release

A friction mechanism having a positive release which has been developed by the writer is shown in Figs. 4, 5, and 6. This device is termed an "overload breaker." Fig. 4 is a sectional view of the device showing the members in the operating position, from which they are disengaged when the tap is overloaded. Fig. 5 is a top view of the mechanism in the same position. In Fig. 6 the mechanism is shown with the driven and driving members disengaged. The various parts of the mechanism are designated by the same reference letters in each of these views.

The driving member *A*, Fig. 4, has a tapered hole at one end and may be fastened to any reversing mechanism. For instance, the friction device shown in Fig. 1 may be replaced by the one shown in Fig. 4. The driven or tap-holding member *B*, Fig. 4, has a running fit on the shank *C* of member *A*. Encased in the latter part is a friction ring *D*, the pressure on which can be adjusted by means of the nut *E*. Ring *D* has three notches on its inner periphery, as shown in Fig. 5, which engage the three outer extensions of the releasing member *F*. These extensions are free to slide in the notches. Member *F* also has three inner extensions *G* which engage V-shaped openings in the driven member *B*, Fig. 4.

Assuming that holder *B* and the tap are prevented from turning while the driving member *A* continues to rotate, the resistance of the friction ring *D*, which is under pressure, will cause the releasing member *F* to be pushed out of engagement with the driven member *B*, so that part *F* will be located in the position shown in Fig. 6. Ordinarily, however, the releasing member *F* is prevented from being disengaged by means of a tooth ring or retainer *H* which is shrunk on the shank of part *C*. During the engagement extensions *G* will be pressed against three of the six retaining teeth of part *H*, so that disengagement of the releasing member *F* can take place only after the friction ring *D* has made one-sixth of a turn. The extensions *G* will then be in a position to pass into the open space between the teeth on part *H*, thus releasing the drive from the driven member and positively breaking the connection between the two.

In order to reset the device, the operator simply draws the releasing member *F* outward and thus engages its extension with the driven member *B*. A pin or pin wrench inserted in the hole *I* may then be employed to turn both members and the friction ring *D* one-sixth of a turn in either direction. It is estimated that there will be 90 per cent less wear on the friction members of a mechanism of the type just described than on mechanisms of the usual design.

Light Weight Parts Essential

In designing tapping mechanisms, the rotating parts should be made as light as possible, as the tap-holder is often stopped very suddenly. This point, however, does not always receive the consideration it should. In some designs, the weight of the rotating members, or their moment of inertia, is sufficient to break the tap, regardless of the operation of the friction driving device. It is evident, therefore, that the rotating tap-holder and the parts attached to it must be made light enough so that their moment of inertia will not exceed the torque which can be safely withstood by the tap.

* * *

JIGS FOR DRILLING PARTS FOR ENGINEERS' TRANSIT

By ROBERT MAWSON

The drill jig shown in Fig. 1 is used in the production of clamp blocks for attaching the variation circle to an engineers' transit. These blocks, two of which are shown at *A* and *B*, are cut from a ring having an inside diameter of 5 inches and an outside diameter of 6 inches. The ring is located in the jig by five shouldered pins *C*. The clamp *D* is tightened on the ring so that it is held securely in position. Six holes are then drilled through the work with a No. 29 drill, the drill being guided by the holes in the tool-steel plate *E*.

The clamp *D* is loosened after the six holes are drilled and the ring indexed in a clockwise direction until the locating pin *F* drops into the next to the last of the six holes already drilled. Then the clamp *D* is again tightened on the ring, and the drilling and indexing operations are repeated until all the holes are drilled. By the use of a jig of this design, accurate results are obtained, and the initial cost of the jig is much less than it would be if enough drill guide holes were provided to permit the piece to be drilled at one setting. After all the holes are drilled, the ring is cut into small sections which are milled as shown by the pieces at *A* and *B*. One of the rings provided thirty-two clamp blocks.

In Fig. 2 is shown the jig used in drilling the socket spindle of a transit. The spindle casting, after being turned and faced to the required dimensions, is placed in the jig in the position shown in the view at the left-hand side of the illustration. The covers *A* and *B* of the jig are swung back on the pivot pins *C* and *D* to permit the spindle to be placed in the jig. When the work is in place these covers are swung back into the position shown, and clamped

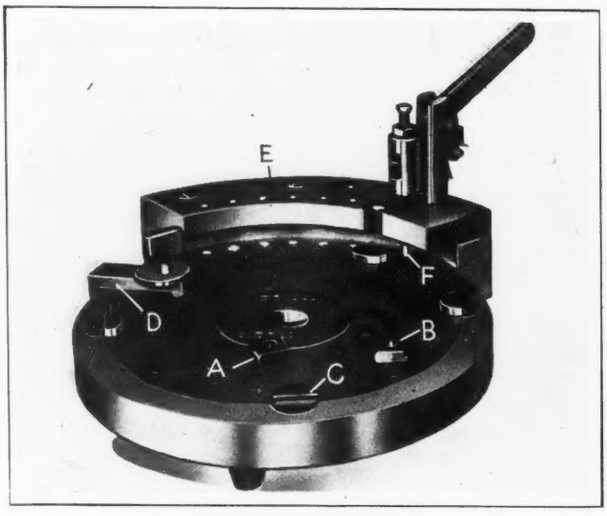


Fig. 1. Jig used in drilling Equally Spaced Holes in a Ring

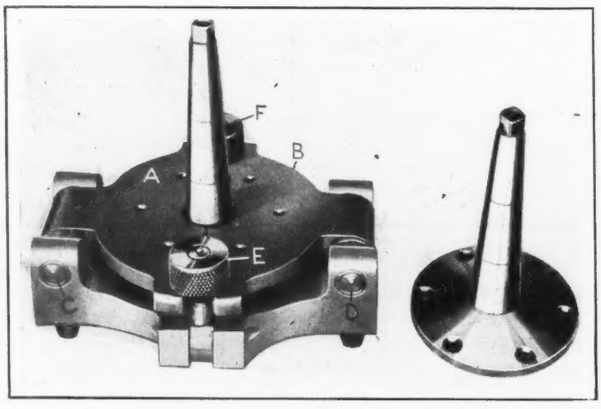


Fig. 2. Drill Jig for Transit Socket Spindle

down on the work by means of the knurled nuts *E* and *F*. The bottoms of the covers, where they come in contact with the spindle, are so machined that they center the work in the jig. The drill is guided by the holes in the covers.

* * *

NEW USE FOR DIE-CASTINGS

A new field for the die-casting process is mentioned in a recent number of the *India Rubber World*, where the methods used in making die-cast golf-ball molds is described. Golf-ball molds have been made by the die-casting process for more than a year, and the marked advantages of molds produced in this way have been fully demonstrated. It is possible in this manner to obtain the same accuracy of dimensions, markings, perfection of surfaces, and durability in service, as from steel molds; and the die-cast molds can be made at a fraction of the cost of steel molds. It is also possible to make changes in the design of markings or names by using cores without incurring prohibitive costs.

Notes and Comment on Engineering Topics

The most effective aid to rehabilitation of the electric railway systems of the country, according to a recent report of the General Electric Co., is the light-weight electric car. Remarkable progress has been made during the past year in the design of this type of car. It is stated that the Cincinnati, Lawrenceburg and Aurora Street Railway, for instance, has saved over a period of 5½ years more than $220,000, simply by operating light-weight equipment instead of the past heavy types of cars.

During the summer of 1923 a regular air service was maintained between Copenhagen in Denmark and Hamburg in Germany. The possibilities for maintaining commercial aviation service are well shown by the record achieved in this case. Between April 17 and October 16 regular service was maintained without a single accident, and of the tours scheduled, 92.3 per cent were maintained, the remainder being cancelled because of weather conditions. It is regarded as one of the best results achieved in any regular aerial service anywhere. Altogether 55,000 miles were covered, and 410 passengers carried.

Manufacturers who may not consider it necessary to have a trademark for their product in the domestic market should remember that trademarks are of considerable value in many foreign countries, and that it is not possible in most foreign countries to obtain a trademark unless it has first been registered in the country of origin. Hence it is of considerable value to have a trademark registered in the United States as soon as a new product for which a trademark is suitable is placed on the market. Then, whenever a foreign trade opportunity offers itself, it is possible to register the trademark abroad without delay.

It has been proposed to standardize aluminum sheet sizes because the automobile body industry would gain through the elimination of many odd sizes of sheets. Through a committee of the Society of Automotive Engineers, the following aluminum sheet sizes have been proposed as standard:

No. 14 Gage: 24 by 72 inches; 30 by 96 inches; 36 by 120 inches; 36 by 144 inches; 48 by 144 inches; 60 by 120 inches; and 60 by 144 inches.

No. 16 Gage: 24 by 72 inches; 30 by 96 inches; 36 by 120 inches; 36 by 144 inches; and 48 by 144 inches.

The tonnage of ocean-going vessels provided with Diesel engines instead of steam engines or turbines is at the present time 1,700,000 gross tons. Of all new ocean-going vessels under construction at the end of the third quarter of 1923, 20 per cent are to be provided with Diesel engines. A year previously, this figure was only 8 per cent, which indicates the rapidly growing popularity in engineering and shipping circles of the oil-engine-driven ship. The largest vessels with oil engines now under construction are two 21,000-ton ships being built at Belfast, Ireland. The main advantages of the Diesel engine ship are said to be the lower operating costs.

In spite of the disturbed conditions in Europe and the difficulties experienced by continental steel plants in obtaining adequate supplies of coke, the rate of steel production in France and Belgium during 1923 was higher than in 1922. The British industries show a similar improvement, the output for the first eight months in 1923 being considerably above the 1913 output, and nearly 50 per cent greater than the production in 1922. The highest-prewar record in the Belgian production was in 1912. During the latter part of 1923 this record figure was exceeded. In Germany, again, the high cost of production, transportation, and raw materials has raised steel prices in that country to a point above the level of the international market; hence new orders have practically disappeared, and the production has greatly declined.

The construction work on the Palace of Engineering and the Palace of Industry at the British Empire Exhibition to be held at Wembley, near London, next summer, is practically completed. These two buildings—which are approximately equal in size, the engineering building being slightly the larger of the two—cover a total area of 23 acres. The Palace of Engineering is a permanent structure and is believed to be the largest concrete building in the world. It has a floor area of over 500,000 square feet, and the five bases are served by main line railways and overhead traveling cranes. These are the two largest structures on the exhibition grounds, but there are also many other buildings devoted to special displays from the various parts of the British Empire. Those that contain the exhibits of Canada, Australia, and India are especially large structures.

In his annual report on the Patent Office, the Commissioner of Patents points out that the 85 additional employes authorized for the present fiscal year will help to reduce the 71,000 applications on hand awaiting action, but that to bring the work up to date within a reasonable time at least 100 more examiners would be necessary. The report also points out that the office is badly in need of additional space. Halls unfit for office purposes are now being used for technical employes and their clerical assistants, so that the additional employes now authorized will tax the building far beyond its capacity. The commissioner also points out in his report the fact that during the last two fiscal years the Patent Office received an average of 9000 applications a month, or 216,170 applications for patents, trademarks, prints, and labels—over 5000 more than in the previous two years. The fees received during the past year amount to $3,026,486, the largest amount ever received.

A century of achievement is recorded in a book recently published in England, entitled "A Century of Locomotive Building by Robert Stephenson & Co." In about another year the hundredth anniversary of railroad transportation will be celebrated in England, and this book is the historical forerunner of this event. George Stephenson built his first engine in 1814, but the firm bearing his son's name was founded in 1823. At the time of the founding of the company it was stated that George Stephenson had been building practical "traveling engines" for nine years. He achieved quite early such a reputation that Stephenson's designs were requested in cases where Stephenson-built engines could not be obtained. The first locomotive on modern lines was the Stephenson "Planet," which, although it had only four wheels, comprised all the essentials of later locomotive building. It was the first engine in which the modern type of drive was adopted from the cylinders in a horizontal position, or nearly so, at the front end, to a driving axle further to the rear.

A Tool-crib System

By M. L. O'FLAHERTY

Form 37

Employee's No. Date

Tool Crib Credit Slip and Requisition

Amount Entering Tool Crib	Note:—Foreman Must Give Full Description of Tools Desired, Also Job No.	Amount Leaving Tool Crib
	T. S. H. S. Drill	
	S. S. Drill	
	Plug Tap	
	Gun Tap	
	T. S. Reamer	
	S. S. Reamer	
	Hand Reamer	
	Shell Reamer	
	Tool Bits	
	Blades	
	Milling Cutter	
	Slitting Saw	
	Center Drill	
	Countersink	
	Chucks	
	Part No.	

☐ To Be Repaired ☐ Broken
☐ Dull
☐ Undersize ☐ Worn Out

Signed

Fig. 1. Tool-crib Credit Slip and Requisition

The majority of factory managers are inclined to consider the tool-crib equipment and its personnel of minor importance. As no work is actually done on the product in this department, it is perhaps natural to regard it as non-productive. For this reason, many executives consider that the less spent on the tool-crib, the better it will be for the balance side of the ledger. In taking this viewpoint, they lose sight of the fact that an inefficiently organized and inadequately equipped tool-crib is a common source of expense. In large plants, this expense or waste may amount to thousands of dollars annually. Lost tools, tools that are scrapped while yet serviceable or that could be salvaged at little cost, hours wasted at the crib windows while the clerk searches for a tool or a misplaced check, are all sources of needless expense that exist in inefficient tool-cribs. Such cribs are certainly non-productive in every sense of the word, whereas the properly managed tool-crib is an outstanding factor in shop efficiency and has proved a decided aid to volume production.

By actual observation in one plant, the writer found that on the average the total time lost each day, by the workmen who were obliged to wait at the crib window, was equivalent to the total daily working time of five employes. The tool-crib clerks in this plant were supplying the men as fast as their inadequate methods would permit, and the managers appeared satisfied, probably because they did not realize the great amount of time that was really being wasted. In such cases, additional clerks will not materially better conditions. Until managers or executives become familiar with the inside workings of the tool-crib, it is difficult to convince them of the savings that can be made by properly equipping and organizing the tool-crib department. The writer has looked over tool scrap piles and found hundreds of pounds of stellite, as well as thousands of pounds of high-speed steel, mixed in with machine steel and cast iron which was all sold as scrap. Good serviceable tools, having a total value of several hundred dollars, were also being sold as scrap. Efficiency in the tool-cribs of such plants had been entirely lost sight of in the "high production frenzy." Scrap metal dealers, however, were being rapidly enriched by this decidedly poor business method.

Proper Tool-crib Equipment

The efficient tool-crib is provided with proper shelving, a systematic arrangement of tools, systematized check boards, a carefully worked out method of handling tools, and above all it is served by intelligent clerks. The model tool-crib clerk is one who knows the use of each tool that he hands out to the workmen at the window, and who serves the workmen just as though they were customers in his own store.

Steel shelving makes the most practical tool racks. It can be readily changed to meet existing requirements and is much more practical than drawers. It requires a few seconds to open and close a drawer and again the open drawer and the man in front of it block the aisle. Rack dividers are efficient and cost less than drawers. The racks should be arranged at right angles to the window side of the crib, with a counter rack on the level with the windows. A passageway should be left at the back of the racks. The check boards should be large; 36 inches by 48 inches is a good size. These boards are placed on the front side of the racks. The label holders that are regularly furnished with the shelving make excellent label holders for the check boards. The rows of hooks can be placed under the labels. If the tool racks are low, the check boards can be 10 or 12 inches wide, placed on the top of the rack, and tilted outward. They may be also run the entire length of the rack. With boards of this kind the checks hang directly over the section where the tool is located. The hinged multi-sectioned check board is undesirable, as it is a time-consumer, especially in a crib where two or more clerks are employed.

Total Classification

The tools should be divided into six general classes: First, standard cutting tools, such as drills, reamers, taps, dies,

C. P. 87 6-22 500M

TOOL REQUISITION

SYMBOL NO. LOCATION DATE 192

QUANT.	D W'G. NO.	DET. NO.	DESCRIPTION	PRICE	EXTENSION

EMPLOYE NO. NAME DEPT.

REASON	X	CAUSED BY	X
BROKEN		CARELESSNESS	
DAMAGED		IGNORANCE	
LOST		ACCIDENT	
WORN OUT		HARD METAL	
NEW WORK		ORDINARY USAGE	
		DEFECTIVE TOOLS	

REPLACE YES NO

USED ON PART NO.

OPER. NO.

CHARGE TO

ORDER NO.

DEPT. NO.

ACCT. NO.

CREDIT

PURPOSE USED

STORE NO.

ACCT. NO.

SIGNED FOREMAN

Fig. 2. Tool Requisition Slip used for Replacements

saws, milling cutters, etc.; second, miscellaneous tools, including wrenches, pliers, screwdrivers, brushes, files and anything else of a standard nature; third, special tools; fourth, jigs and fixtures; fifth, gages, including micrometers and precision tools; and sixth, grinding wheels. Each class has a separate rack section and each size has a properly labeled pocket. The check board for the standard cutting tools has a hook for each size. The board for the miscellaneous tools has a hook for each kind of tool and perhaps ten hooks for the tools that are checked out in quantities. These hooks are numbered from 1 to 0, and the last number on the tool check indicates on what hook it belongs. This saves time in finding the check when the tool is returned.

Special tools have a separate hook which is usually designated by the tool number. Jig and fixture check boards have a hook for each jig. The jigs are given out with the necessary tools for the set-up on one check, a card system being used which provides a list of the tools that go with the jig for a particular job or operation. A card, 3 by 5 inches in size, is large enough for this purpose, and these cards can usually be arranged numerically. Gages have individual hooks on the check board, and are identified by number or size. It is advisable to have all micrometers and precision tools numbered and a check hook for each individual piece. A good way to number micrometers is to prefix the number with the letter "A" on the 1-inch size, the letter "B" on the 2-inch size, and so on. When tools of the fourth and fifth class are sent to the tool-room or outside the plant for repairs, a repair check should be hung on the hook. In this manner, the crib man always knows where these tools are. A check board is not necessary for grinding wheels, as these are given out on replacement orders or requisitions.

Checking out Tools for Production Work

All production tools are checked out, except the initial tools and their accessories that remain set up on a production machine. Tool kits for assembly work, or machine work requiring a number of tools, may be made up and numbered, their contents being listed on a card. A baggage check is also made out which bears the same number as the kit. The employe using this kit exchanges a tool check for the baggage check, his number being noted on the list card. His tool check is not returned to him as long as he remains on that job, but he is given the baggage check when the kit is turned in over night.

Broken and worn out tools are replaced by new ones on the foreman's order. Two forms of this requisition are shown in Figs. 1 and 2. These requisitions can be forwarded daily to the tool supply department for replacements, and thence to the cost department. A tool cost sheet can be readily compiled for each department. If desired, the backs of the requisition forms can be used for orders from the foreman to the belt men or machine repair men.

The broken and worn out tools received on these requisitions are forwarded daily to a salvage crib and are sorted by a competent man. Tools that can be salvaged are kept.

Form 42

TOOL CRIB "O. K."

Employee's Name No.

Short

Date Signed

NOT GOOD IN PAY OFFICE OR BADGE STATION

Fig. 4. Tool-crib "O. K." Card given to Employe when he leaves

Form 136

CLEARANCE

Empl. Name Clock No. Date

SHORT	SIZE	AMT	SHORT	SIZE	AMT.	BADGE
Brass Check						

Transfer New No. Hold up Quit

Signed

Fig. 5. Clearance Slip for Final Pay

High-speed steel scrap is boxed by itself. Separate boxes are also maintained for machine steel, cast iron, bronze, etc. The broken tools may be looked over daily by the various foremen, and the cause of the breakage determined and corrected. Reports of broken tools can also be made out daily from the requisition forms. Obsolete tools are forwarded to the salvage crib and not allowed to accumulate in the production cribs.

One crib can be designated as the "clearance crib," and all tool charges made here. Checks are issued from it and charged to the employe on a card such as shown in Fig. 3. Tools kept in the employe's possession can be charged on this card. When an employe leaves the service he is given a tool-crib "O. K." slip, such as shown in Fig. 4, which is issued at the crib where he has drawn tools. The clearance crib issues the clearance slip upon presentation of the tool-crib "O. K." card. Clearance slips are made in duplicate, one copy being retained at the clearance crib as a record. In case tools are lost or unaccounted for, the employe will be required to obtain a crib "O. K." card from all cribs reporting such losses. A tool clearance slip that serves for any or all charges against the employe is shown in Fig. 5.

The contents of all tool boxes brought into the plant by workmen should be checked and listed at the tool clearance crib. Tools furnished by the company should not be allowed to be kept in the tool box of a

Form 39

EMPLOYEE'S NAME BADGE No.

DATE TOOL CHARGES

DATE	NAME OF TOOL	EMP. SIG.	CLERK'S SIG.
	No. of Checks Issued		
	No. of Checks Issued		
	No. of Checks Issued		

Clearance Issued by Date Reason

Five day hold up

(See back of this card for additional charges)

Fig. 3. Slip for recording Tool Charges against Employes

workman, especially the cutting tools that do not bear the company's stamp. When an employe owning a tool box checks out his box, it is examined and its contents checked. A pass is then issued by the tool supervisor. All passes for tools that are taken out of the building should be signed by the tool supervisor only.

The tool-crib system described in this article has given good results and is not expensive to install. It saves hours of labor and prevents tool waste, a factor that cannot be overlooked in either large or small shops. The business of handling tools can thus be handled with an accuracy that is in keeping with the accuracy demanded in the productive part of the plant. With such a system in operation, the crib window is no longer a place where the machine operator can loaf or waste time. His business is transacted there and he is back at his machine in only a few minutes time.

* * *

SELECTION OF CHAIN LUBRICANTS

The essential requirement of a chain lubricant is that it penetrates to the rollers, rockers, or sliding surfaces of the link. It is useless to apply lubricant to the surface of a chain if it has not the penetrative ability to reach all the wearing parts. The following points on the selection of lubricants for chains and methods of applying the lubricants which appeared in a recent number of *Lubrication* published by the Texas Co., New York City, may be of value tc many chain users.

Chains of simple design, such as the detachable pintle types, may or may not require lubrication, according to the nature of the service they perform. Wherever possible, it is advisable to apply a lubricant, unless the chains actually operate in contact with an excess of foreign matter, in which case a lubricant would be more of a detriment than a benefit. For detachable and pintle chains, a relatively heavy lubricant of from 1000 to 2000 Saybolt viscosity at 210 degrees F. will be found suitable.

In nearly every case, some means of supplying lubricant should be provided for roller chains. Often, however, little regard is given to roller chains, owing to their seemingly rough construction, and waste oils are often carelessly poured on the chains at regular intervals. Waste oils will lubricate, but as they often contain an appreciable amount of sludge and abrasive matter, their use is not recommended. It is better to use a lubricant similar to that recommended for pintle and detachable chains, or if conditions warrant its use, a lighter oil may be employed.

On chains of the types referred to, it is customary to brush the lubricant uniformly over the wearing surfaces while the chain is running at a slow speed. It will be found advisable to heat the lubricant in order to facilitate the spreading of an even, thin coating. Silent chains may or may not be enclosed in an oil-tight casing. The speed of operation often determines whether or not a casing should be used. In all cases, however, where much dust, grit, or other foreign matter is likely to come in contact with the chain, it is advisable to enclose the chain in an oil-tight casing, regardless of the speed at which the chain operates. Naturally a chain that is enclosed in a dust-proof oil-tight casing, equipped with some form of automatic lubricating device, will require less attention and operate more efficiently than one not so equipped.

The principle of splash lubrication by means of a disk attached to one side of the main shaft is employed effectively in lubricating chains enclosed by an oil-tight casing. As the shaft rotates, the disk dips into the oil in the base and throws it to the top of the casing, which is built in the shape of a wedge with the vee located over the center of the chain. With this construction, there is a continuous and uniform dripping of oil on the chain. In casings of this type, the oil level is below the chain and the disk dips into the oil to a depth of ⅛ inch or more.

Other types of casings depend upon bath lubrication, in which event the oil level should be somewhat above the lowest part of the chain. Casings that are used on high-speed chains are often equipped with an oil-pump. Forced lubrication is thus attained and the oil sprayed continually upon the chain.

When silent chains are operated exposed, the lubricant must be applied either by brushing it uniformly over the driving surface, or by removal and immersion of the entire chain. Certain manufacturers of chains of this nature treat them with the lubricant before they leave the factory. Usually a soaking bath is used, the chains being immersed for a sufficient length of time to allow penetration to all interior parts. Such a treatment will insure efficient lubrication over at least a month of normal operation. Subsequent soaking of the chain in the lubricant at periodic intervals is advisable wherever possible.

When it is impossible to remove a silent chain for such treatment, the bearing or driving surface should be brushed or otherwise treated with a light uniform coating of lubricant about once a week, or more frequently if necessary. If this is done during slow operation, satisfactory penetration will occur to all the joints through the combined effects of bending and capillary action.

As clearances in silent chains are usually very small, it is generally advisable to use a relatively fluid straight mineral lubricant. When chains are encased, if they are to be bath-lubricated, an engine oil having a viscosity of about 500 Saybolt at 100 degrees F. will be suitable. Where exposed, or encased but not submerged in oil, a heavier lubricant, such as a mineral cylinder oil or light gear compound, should be used. Considerable difference of opinion often arises as to the use of greases or other semi-solid products. In many cases these would serve the purpose admirably, especially on such chains as have sufficient clearance to enable proper penetration. Still it can be appreciated that the lubricant must have a certain ability to flow, and we cannot always depend entirely upon capillary action to bring about suitable penetration to the pins, bushing, or rockers.

In conclusion, it is well to remember that chains and casings will often require cleaning, especially if operating conditions are not of the best, or entry of dust or dirt occurs. In such cases, a kerosene or gasoline wash will be found satisfactory. Chains should be removed if possible and immersed in this wash. Cases should also be drained and rinsed out to insure the removal of all sediment that may have collected.

* * *

STANDARDIZATION IN GERMANY

The extent to which Germany has so far succeeded in keeping her industrial machine intact is due in no small part to the elaborate scale on which her standardization work is performed. The standardization work in Germany is described in considerable detail in a bulletin prepared by Dr. P. G. Agnew, secretary of the American Engineering Standards Committee, 29 W. 39th St., New York City, who recently returned from Europe. While there, he studied for two months the standardization movement and the manner in which the European nations are handling this work. He also gave considerable attention to the effect that the European developments are likely to have on American industry and exports.

Practically every important manufacturing concern in Germany is participating in the industrial standardization program of that country. More than a thousand German companies have actual standardization organizations within their own works. The extent to which industrial life in Germany has been coordinated is shown by the fact that more than 700 German national standards have been adopted, including standards in the machine shop industry, such as standard shaft diameters, tapers, sizes of keys, threads, fits, measuring instruments, gages, specifications for materials, machine handles, ball bearings, journal bearings, gearing, and even sizes of drawing paper.

CUT OUT ON THIS LINE

PUNCH

PUNCH

PUNCH

PUNCH

Punch-holes are spaced to fit standard loose-leaf

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. ○ PUNCH

CUT OUT ON THIS LINE

HELICAL PHOSPHOR-BRONZE SPRINGS

Size of Wire, B. & S. Gage	Diameter of Wire, Inches	Constant	Mean or Pitch Diameter of Spring, Inches									
			1	7/8	3/4	5/8	1/2	3/8	5/16	1/4	3/16	
9	0.1144	35.3	35.3 0.274 129	40.2 0.213 185	46.5 0.156 300	55.9 0.108 520	70.6 0.069 1030	80.3 0.053 1480	.....	.....	.....	.....
10	0.1020	25.0	25.0 0.308 81	28.6 0.236 121	33.3 0.173 192	40.0 0.120 333	50 0.077 650	57 0.059 968	For complete directions, see Data Sheet No. 23, December, 1923.			
11	0.0907	17.6	17.6 0.346 50	20.1 0.264 77	23.5 0.194 122	28 0.135 211	35.2 0.086 410	40.2 0.066 614	47 0.049 975	.....	.....	.....
12	0.0808	12.43	12.43 0.388 32	14.2 0.298 48	16.6 0.219 78	19.9 0.152 130	24.8 0.097 256	28.4 0.074 380	33.1 0.055 600	.....	.....	.....
13	0.0720	8.80	8.80 0.435 20	10 0.334 30	11.7 0.246 48	14 0.170 83	17.6 0.109 160	20 0.084 240	23.4 0.061 380	28 0.043 660	.....	.....
14	0.0641	6.19	6.19 0.490 12.6	7.07 0.375 19	8.25 0.270 30	9.90 0.192 51	12.4 0.123 100	14.1 0.094 150	16.5 0.069 240	19.8 0.048 400	.....	.....
15	0.0571	4.36	4.36 0.550 8	5.00 0.421 12	5.80 0.310 19	7.0 0.215 33	8.7 0.138 63	10 0.105 96	11.6 0.078 150	14 0.054 260	17.4 0.034 500	.....
16	0.0508	3.09	3.09 0.618 5	3.53 0.474 7.5	4.12 0.348 12	4.94 0.242 20	6.18 0.155 48	7.06 0.118 60	8.24 0.087 95	9.89 0.060 163	12.36 0.039 320	.....
17	0.0453	2.15	2.15 0.698 3	2.47 0.535 4.6	2.86 0.392 7.3	3.43 0.274 12.6	4.30 0.174 25	4.94 0.134 37	5.72 0.098 58	6.87 0.068 100	8.59 0.044 197	11.5 0.025 460

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MACHINERY'S Data Sheet No. 27, New Series, February 1924 Contributed by Joseph H. Sullivan

CUT HERE

HELICAL PHOSPHOR-BRONZE SPRINGS

Size of Wire, B. & S. Gage	Diameter of Wire, Inches	Constant	Mean or Pitch Diameter of Spring, Inches										
			1 1/8	1	7/8	3/4	5/8	1/2	3/8	5/16	1/4	3/16	1/8
18	0.040	1.51	1.34 0.976 1.35	1.51 0.785 1.92	1.72 0.600 2.86	2.00 0.442 4.3	2.41 0.307 7.9	3.00 0.196 15.4	3.44 0.150 23	4.0 0.110 36	4.8 0.077 63	6.0 0.049 123	8.0 0.028 290
19	0.036	1.10	1.00 1.104 0.90	1.10 0.873 1.26	1.26 0.668 1.9	1.47 0.491 3	1.76 0.341 5	2.20 0.218 10	2.51 0.167 15	2.93 0.123 24	3.52 0.085 41	4.40 0.055 80	5.87 0.031 190
20	0.032	0.772	....	0.772 0.984 0.79	0.882 0.752 1.2	1.03 0.552 2	1.24 0.384 3.2	1.54 0.246 6.3	1.76 0.188 9.4	2.06 0.138 16	2.47 0.096 25	3.09 0.061 50	4.12 0.035 120
21	0.0285	0.545	....	0.545 1.104 0.49	0.624 0.844 0.73	0.725 0.620 1.15	0.872 0.431 2	1.09 0.276 3.9	1.25 0.211 5.8	1.45 0.155 9	1.75 0.108 16	2.18 0.069 31	2.91 0.039 74	4.36 0.018 250
22	0.0253	0.381	....	0.381 1.240 0.32	0.436 0.951 0.49	0.508 0.700 0.70	0.610 0.484 1.34	0.765 0.310 2.6	0.872 0.238 3.9	1.02 0.175 6	1.22 0.121 10	1.54 0.078 21	2.03 0.044 49	3.06 0.019 167
23	0.023	0.287	....	0.287 1.364 0.21	0.326 1.044 0.31	0.382 0.768 0.50	0.457 0.534 0.86	0.573 0.342 1.68	0.653 0.261 2.5	0.764 0.192 4	0.914 0.133 7	1.15 0.086 13	1.53 0.048 32	2.39 0.022 105
24	0.020	0.1885	....	....	0.215 1.231 0.18	0.250 0.880 0.28	0.301 0.613 0.50	0.375 0.393 0 95	0.430 0.301 1.43	0.500 0.220 2.3	0.603 0.153 4	0.750 0.098 7.7	1.00 0.055 18	1.50 0.025 60
25	0.018	0.1368	....	....	....	0.183 0.976 0.19	0.219 0.681 0.32	0.273 0.437 0.63	0.313 0.334 0.93	0.365 0.244 1.5	0.438 0.170 2.6	0.547 0.108 5.3	0.730 0.061 12	1.10 0.027 42
26	0.016	0.0965	For complete directions, see Data Sheet No. 23, December, 1923.			0.154 0.768 0.20	0.193 0.491 0.38	0.220 0.376 0.57	0.257 0.276 0.90	0.309 0.192 1.6	0.386 0.123 3.1	0.515 0.069 7.3	0.772 0.031 25

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MACHINERY'S Data Sheet No. 28, New Series, February 1924 Contributed by Joseph H. Sullivan

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, January 14

THE past year closed with improved prospects of business expansion. It has been the experience of many firms in the metal-working industries that the last three or four months have shown a cumulative improvement. Stocks generally have been depleted, and this is reflected in a growing demand and a rising tendency in the price of raw materials. Buyers of raw materials are placing orders further ahead, and the extreme caution of the last few months is giving way.

The Machine Tool Industry

Among machine tool makers, prospects continue to improve, and orders are now being obtained more easily. A systematic review of the machine tool improvements initiated during the past year shows a degree of enterprise that is remarkable in view of the general depression. Developments have not been confined to any one or two classes of machines, but the most striking departure has been in the construction of special automatic machines for performing several operations at one time.

Manufacturers of screw machines have a good deal of new work coming through, and some firms making lathes for textile machinery work and brass finishing are also busy. Planer builders are quiet, but generally have enough standard work in hand to keep their shops fairly well occupied. Firms specializing in heavy machines for the rolling stock industry are fully employed, and view their prospects with satisfaction. The demand for special-purpose machines remains good. Makers of gear-cutting machines are obtaining some new orders, and one firm reports heavy puncher slotters in demand both home and abroad.

Exports and Imports of Machine Tools

The improvement noted in the export of machine tools during October was fully maintained in value during November, but the tonnage was lower, although still considerably above the average for the year. The exports in November totalled 1461 tons with a value of £157,676, as against 1675 with a value of £153,436 in October. The imports in November were valued at £48,749 for a tonnage of 382, figures that differed little from the average for the whole year. In November the value per ton of exports was £108, and of imports £128.

The total exports for the first eleven months of 1923, compared with an average of the same eleven months from 1911 to 1914, were in the ratio of 12.9:14. The ratio of the respective totals for value were 85: 138, while the value per ton of exports is now £106 compared with £61 in pre-war days.

General Engineering Field

In other branches of the engineering industry an increased confidence in the prospects of improved trade is felt. The enormous expenditure of the home railways, to which reference has been made in previous articles, is naturally the chief cause for optimism, and there is hardly any engineering industry that is not likely to reap substantial benefit from the orders now being placed.

The improvement in the textile machinery trade is maintained, and some firms who had to reduce their working days to four have been able to resume full time. Builders of electrical generating equipment maintain their record of plentiful work. Locomotive builders in the Leeds area have received several important orders. One large maker of cranes reports more orders on hand than at any time since the armistice; during the last three months orders for twenty overhead traveling cranes have been received. Firms specializing in heavy gear-cutting are busy, many of their orders coming from overseas. There is a strong tendency to replace steam-driven hammers by those using compressed air. A good demand for cable-making machines is caused by the rapid development of electric lighting schemes; the machines used for these products are often 120 feet in length, and this makes the plant additions necessary to cope with increased work, a matter of no little difficulty.

The position of the steel industry in Sheffield is still improving and there is a very hopeful outlook for the new year; idle equipment is being made ready for operation, and raw material contracts are being fixed up much more rapidly. There is a better demand from the United States and also from South America for special steels. Some of the departments working on railway material requirements are busy day and night. The Scottish iron and steel trade is also confident that the new year will see a steady expansion of business.

The Automobile Industry—Shipbuilding

In the automobile industry preparations are being made for next season's sales, which are expected to be larger than ever. Price-cutting has reached its limit—at any rate for the time being—and only the best organized and equipped firms are likely to find the market profitable. Inquiries for light cars are coming in from all over the world, with the exception of America and Canada, and substantial business has already been transacted with the Colonies and several Continental countries. Motorcycle and bicycle firms are also busy, and works are running full time. Australia and Japan are the principal overseas markets, but very satisfactory orders are also being received from Belgium, Holland, and Sweden.

The position of shipbuilding is much improved, and new cargo vessels are being ordered on a fairly large scale. At the end of November there were 467,000 tons building on the Clyde, and since then important orders have been placed. Considerable repair work is being done.

Labor Conditions

The unemployment returns for November showed a fairly steady tendency toward improvement in most industries, and was especially noticeable in railway, electrical, printing machinery, and automobile shops. In the pig iron industry unemployment in November was 11.8 per cent, compared with 15.5 for October.

New Machine Tools

Among new tools placed on the market during December a new combination turret lathe is perhaps the most interesting. It is only a 7-inch center machine but admits up to 36 inches in front of the spindle nose, as against 18 inches in a corresponding size of screw machine. The firm of H. W. Ward & Co., Ltd., who build this machine have also designed an 8½-inch combination turret lathe, a striking feature of which is the one-piece bed casting, which stands in a capacious tray at floor level. Another new machine tool of interest is a railway car wheel lathe, built by Joshua Buckton & Co., Ltd., Leeds, which is suitable for wheels up to 43 inches in diameter.

EDITORIAL COMMENT

on Mechanical Subjects of Current Interest

A SUCCESSFUL APPRENTICESHIP SYSTEM

The leading article in this number of MACHINERY describes the methods used by a large machine tool company in conducting what has proved to be an exceptionally successful apprenticeship system.

We hear often that it is impossible at the present time to accomplish this in the machine-building industry, and that boys cannot be induced to apprentice themselves to learn the machinists' trade. "If they actually begin the apprenticeship," it is said, "they do not complete it; and if they complete it, they do not stay with the firm that has spent time and effort in training them."

Not one of these assertions has been found to be true in the experience of the company whose system is described. Forty years ago in this shop an apprenticeship system was instituted, and ever since apprentices have been thoroughly and systematically trained by carefully considered methods, which from time to time have been developed and amplified to meet the more exacting needs of the machine-building industries. If anyone questions the possibility of conducting a successful apprenticeship system, this plant furnishes the answer.

But do the apprentices stay with the company referred to, after having finished their years of training? Some of them do not, but a great many do. In the plant mentioned, former apprentices now hold the positions of works engineer, superintendent, assistant superintendent, production engineer, chief draftsman, and employment manager. Several of the district sales managers, and many of the foremen, inspectors, demonstrators, toolmakers and machinists now working in the plant served their apprenticeships right there. Of those who left, some have established successful businesses of their own and the system has worked generally to the advantage not only of the employing concern, but of employes who completed their apprenticeships and to whom opportunities opened to move upward in their chosen field.

The results in this plant can be secured elsewhere. If all the larger machine-building plants maintained systematic apprenticeship courses, the industry as a whole would benefit greatly. MACHINERY believes so thoroughly in this kind of training that we can hardly give too much space to articles relating thereto.

* * *

JOBBING SHOP COST ACCOUNTING

The manager of a jobbing shop must solve many problems that do not occur often in a plant manufacturing a standard line of machines, tools, or other products. The cost accounting in a shop that produces repetition work is comparatively simple; costs are readily ascertained and selling prices necessary to cover costs and a profit can be determined accurately. In the jobbing shop conditions are quite different. Whether the work consists of building special machinery or doing repair work, its character changes constantly. In making advance estimates of costs, records that can be consulted are seldom available, but experience and judgment and considerable guesswork affect the figures. While it is not possible to estimate costs in a jobbing shop as accurately as in a plant manufacturing the same product continuously, there is no reason why records of the cost of jobbing work should not be kept; these records could then be consulted when bidding on contracts for similar work, and a more accurate estimate could be prepared.

As the average-sized jobbing shop cannot afford an elaborate cost accounting system, we suggest a simple card, following each job, on which is noted the number of hours spent thereon by each workman and the amount of steel and iron or other material used. To the total cost represented by these should be added a percentage for overhead —an item often underestimated by jobbing shops; but on such work not usually less than 50 per cent and sometimes 100 per cent. Individual experience only can determine the exact percentage.

The advantage of an accounting system is twofold: (1) It is possible, after work is completed, to check up the estimate with the actual cost and to determine whether a profit or a loss resulted; (2) while no future job may be identical with the one in hand, the latter may be sufficiently similar to ensure a fairly accurate cost estimate, dispensing with guesswork.

Many jobbing shops have failed because of work taken at too low a price. Several of the tool shops that prospered during the war, when almost any price could be obtained for their work, failed when prices fell, because without knowing it, they were getting less than cost for their work. During the recent business depression one large concern in the Middle West that had plenty of work because its prices were low, recently failed because it netted a loss on most of its contracts.

Such cost accounting as we have suggested for the jobbing shop is an important item, and every business of that kind should compare the estimates with the cost of the completed work, thereby establishing a basis for correct future estimates.

* * *

WASTEFUL QUANTITY PRODUCTION

We have become so accustomed to conceding the economy of quantity production that we sometimes do not consider that this method, when applied without proper judgment, may be wasteful instead of economical. The temptation always exists to produce parts in quantity in order to reduce the cost per piece, even when the parts are not required for immediate use. We were recently shown a supply of parts in a machine tool plant that had been produced in sufficient quantity to meet the normal requirements for assembling finished machines for five years. It is true that the parts were produced at low cost, but in case of a change in the design of the machines for which they are required—which is probable—all the parts that remain will have to be scrapped.

Manufacturers having a comparatively limited output should consider the difference between quantity production for immediate requirements, as in the manufacture of automobiles, sewing machines, typewriters, cash registers and similar machines, and the making of quantities of parts that may not be used for years. It is doubtful economy to tie up capital in stock, with the risk of waste, in order to reduce slightly the production cost per piece. In the manufacture of machine tools, designs change so rapidly, on account of the progressive spirit in that industry and the pressure of competition, that parts produced for requirements too far in the future are very likely to prove a complete loss. Machine tool builders are beginning to recognize that in their industry production in moderate quantities, with no losses due to unused inventories, is usually economical policy; there are exceptions where production in large quantities is possible, but it is not the rule.

CAREFUL MARKING OF EXPORT SHIPMENTS

Distinct marking is absolutely essential in the export trade. The Department of Commerce calls particular attention to this matter in a bulletin recently sent out to the business and trade press. However carefully an exporter may construct crates and boxes and pack machinery and tools, if the marking is illegible, easily rubbed off, or becomes blurred and unreadable through dampness or through the rubbing of one package against another while in shipment, serious delays and even complete loss are likely to result. Too much emphasis, therefore, cannot be placed on the need for careful marking of export shipments.

The principal causes of complaint are that some exporters use brush marking, which is often illegible, or too small stencils, or ink lacking in delible qualities. Another common fault is lack of attention to consecutive numbering of cases, crates, or boxes that are part of one complete shipment. In some countries the customer is subjected to fines when shipments are not properly numbered in this way. In Brazil, for example, lack of consecutive numbering submits the buyer to a heavy fine, and in Salvador, crates bearing duplicate numbers are considered contraband and are liable to a fine of 25 per cent of the duty.

Stencil marking used by American exporters in general is too small. Even large crates and cases are frequently marked with stencils only 1 inch high. Shipments from other foreign countries are generally marked with letters from 3 to 5 inches high, and the address and marking are often legible at a distance of several hundred yards. Generally speaking, stenciled letters should not be less than 2 inches high, and on large crates letters 5 inches high would not be too large.

All lettering should be stenciled. Brush marking, aside from the fact that it is prohibited by some countries, is very unsatisfactory for foreign shipments. As a rule, the complete address and other marking should be placed on at least two faces of the crate or box. Some exporters mark both the sides and the top and bottom. It is important that all marking agree in every detail with the statements shown on invoices and bills of lading. Everything pertaining to address and marking should be together in one place on the crate or box, and the name of the consignee, destination, and route should be at about the center of the face on which the marking is placed. English and German shippers generally mark the address in black, while such markings as weights, cubic measurements, and serial numbers are marked in red.

The use of a good quality of black waterproof stencil ink or paint is of first importance. Many exporters cover all marks with a coating of shellac, which is an excellent means of preventing dampness, water, or rubbing from damaging the marking. For the information of exporters, the composition of the United States Army stencil black standard paint is given as follows: Pigment, 50 per cent; liquid, 50 per cent. The pigment consists of drop black, 50 per cent, and calcium carbonate, 50 per cent. The liquid portion consists of clear spar varnish, 70 per cent; and combined dryer and thinner, 30 per cent. The thinner consists of turpentine of volatile mineral spirits.

A packing list should be enclosed within each crate or box, showing the contents of the case. Each case should also contain a duplicate set of the outside markings, so that if the exterior markings are defaced, there will still be ample information inside the crate or box to insure delivery of the goods to their proper destination. Every unnecessary mark, whether it be in the nature of advertising or irrelevant instructions, should be avoided on the outside of the case, crate, or box. Any such additional marking makes the address and other required information more difficult to find and read. Finally, it might be mentioned that caution marks, such as "fragile," "handle with care," are not of much value unless they are in all the languages of the countries where the shipment will be handled by stevedores or freight handlers.

* * *

The necessity for vocational education was emphasized by C. S. Coler of the Westinghouse Electric & Mfg. Co., before a recent meeting of the American Management Association. Mr. Coler pointed out that a new system of apprenticeship must be developed in cooperation with public educational institutions in order to give the youth of the country a real opportunity to learn a trade or business. Present haphazard methods must give way to more systematic plans, and the new generation must be taught to produce in proportion to what it consumes. The task can be carried out only by cooperation between the public schools and the industries, with such backing from the homes as it may be possible to obtain by impressing upon parents the value of proper training.

PRIZE COMPETITION

MACHINERY offers fifteen prizes for the best articles submitted on

The Most Interesting Job I have ever Seen Performed on a Bench or Engine Lathe

This has been selected as the subject for a prize competition because many of the most interesting operations in machine shops are performed on some type of lathe. In its operation, the machinist or toolmaker has unusual opportunities for employing original methods or special devices, particularly if the job is out of the ordinary. The object of this prize competition is to secure for publication in MACHINERY unusual examples of either engine or bench lathe work, with a view to benefiting all users of this important type of machine.

For the best articles on this subject MACHINERY will award fifteen prizes:

Two prizes each will consist of MACHINERY'S Encyclopedia.

Two prizes each—ten volumes of MACHINERY'S Mechanical Library.

Four prizes each—five volumes of MACHINERY'S Mechanical Library.

Seven prizes each—three volumes of MACHINERY'S Mechanical Library.

The winner may select from the twenty-eight volumes of the library the titles he prefers. Should a winner of MACHINERY'S Encyclopedia already own this work, he may select, instead, any fifteen volumes from the Mechanical Library. In addition to the prizes awarded, regular space rates will be paid for the prize-winning articles when published in MACHINERY.

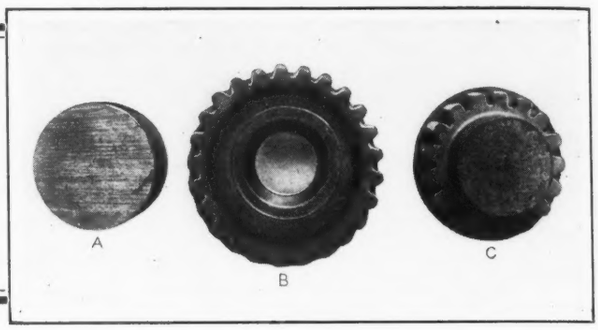
Complete information relating to the competition and the book prizes awarded, with helpful suggestions for competitors, will be found on Advertising Pages 102 and 103 of this number of MACHINERY.

April 1, 1924, is the closing date for the receipt of manuscripts for this competition, which should be addressed to the Editor of MACHINERY, 148 Lafayette St., New York City. Articles that are not awarded a prize may, nevertheless, be accepted for publication, in which case they will be paid for at regular space rates. Manuscripts that are not published will be returned.

Hot-Pressing Steel Parts

New Application of a Process Heretofore Employed Only in Manufacturing Parts from the Softer Metals

By EDMUND W. ZEH, President
The Zeh & Hahnemann Co., Newark, N. J.



BRASS, bronze, aluminum, and other soft metal parts have been produced for some years by hot-pressing in dies used in friction screw or percussion presses, but it is only recently that steel parts have been manufactured in this country by this process. That the process would be practical was apparent from the fact that steel parts of an endless variety had for years been satisfactorily hot-pressed in European countries. Briefly, the process consists of heating slugs of steel to about 1800 degrees F. and then pressing them to the desired shape in tungsten steel dies having cavities corresponding to the outside of the desired part. The steel slugs, of course, must have about the same cubical contents as the pressed part.

Producing Automobile Transmission Gears

An important application of the hot-pressing process is in the production of chrome-vanadium and chrome-nickel steel gears for automobile transmissions. The gears, with the teeth formed, are made at one blow on a Zeh & Hahnemann No. 20 percussion press which delivers a pressure of 400 tons. Two interesting examples of this sort are illustrated in the heading illustration. The gear shown at *B* has an outside diameter of about 3 13/16 inches, a face width of ¾ inch, and 25 teeth of 7 diametral pitch. This gear is made from the slug shown at *A* which is 2¼ inches in diameter and about 1¾ inches long. On the pinion shown at *C* the hub diameter is that of the original slug. This pinion has an outside diameter of about 2 13/16 inches, a face width of 13/16 inch, and 17 teeth of 7 diametral pitch. The hub is 1¾ inches in diameter and ¾ inch long. These gears are produced singly at an average rate of about ten per minute, but higher rates of production could be obtained with dies designed for making two or more gears at the same time. Bevel gears can be produced as satisfactorily by the hot-pressing process as gears of the spur type.

Both examples illustrated are pressed with a thin fin along one side of the tooth faces, which could be eliminated by changing the design of the die. However, in these particular pieces the fin does not matter, because a light cut is taken on the teeth to finish them, and they are then heat-treated, after which they are ground. The allowance for finish-cutting and grinding all around is about 1/16-inch. It would be possible to produce the teeth closer to size and finish them by grinding only.

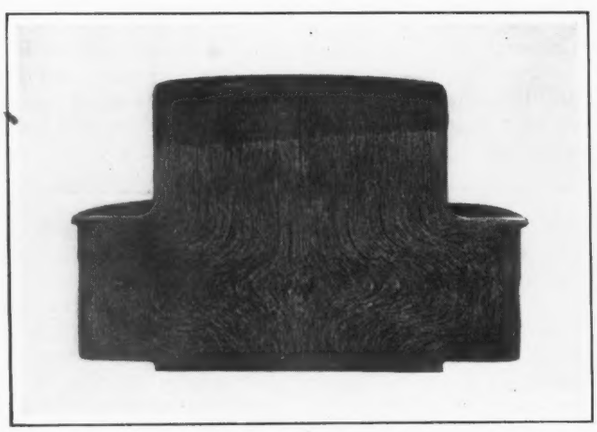


Fig. 1. Etched Section of a Hot-pressed Steel Part showing the Transformation of the Fibers

The major advantages of hot-pressing gears are high speed of production and saving of material. The latter factor is especially important when the gears must have hubs. A final advantage is greater strength of the gear. In the ordinary gear machined from bar stock, the fibers run parallel with the axis of the bar, but after a hot-pressing operation, the fibers tend to run radially toward the outside of the teeth, thus increasing the resistance of the teeth to stresses. This formation of the fibers is clearly illustrated in Fig. 1, which shows an etched section of a pressed chrome-vanadium part. It will be evident that the greater the displacement of the metal in the operation, the more pronounced will be the radial fibers. With the gear shown at *B* in the heading illustration, the displacement was approximately 100 per cent, while pinion *C* has fibers running about as shown in Fig. 1. The density of hot-pressed parts is greater than that of the bar from which the slug is cut. A larger diameter slug *A* (see heading illustration) could be used for gear *B*, but then the slug would need to be sawed from the bar stock, whereas now it is simply sheared with a considerable saving of time. Also with a larger diameter slug the radial direction of the fibers would be less pronounced.

Making Manganese Ore-crushing Balls

The hot-pressing process has also been applied in making manganese balls for crushing ore. Attempts to produce these balls by casting or by forging under the hammer or hydraulic press brought rather unsatisfactory results, the balls breaking quickly when used. These results were due to internal strains which this metal is subject to. Balls for this purpose produced in the percussion power press were subjected to a test in which they were dropped thirty feet to break up scrap castings, and were not broken. This results is credited to the cumulative, penetrating blow the percussion press yields, in connection with the time element.

Valve Tappets with Cast-iron Heads

Another application of hot-pressing which is of exceptional interest is pressing the heads of automobile-engine valve tappets to shape on the steel stems, as illustrated at *A*, Fig. 2. The important fact about this operation is that the heads are produced from close-grained cast-iron slugs having a hole slightly larger in diameter than the stem. The stem is threaded at the upper end so that the head

cannot work loose after being pressed on, because the cast-iron fills the threads. The head is pressed to an outside diameter of 1⅜ inches from a slug 1 inch in diameter. The stem is ⅜ inch in diameter and held vertically in the die for the operation. The right-hand tappet at *A* is shown with the head fractured. In this example, there is no fin, the dies being designed so as to eliminate it and so the tappet is ready for use after a grinding operation on the seat.

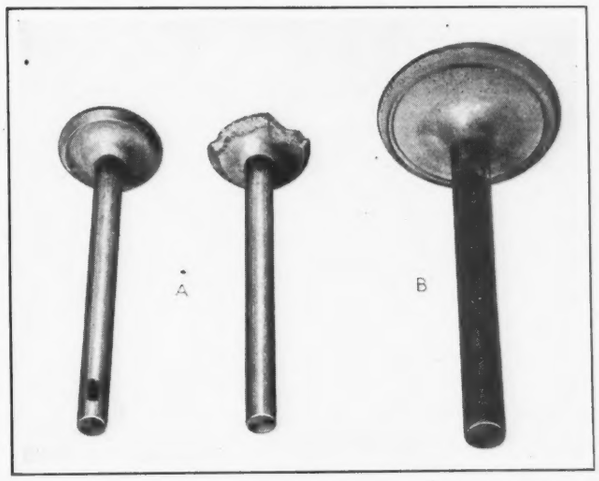


Fig. 2. (A) Automobile Valve Tappets with Cast-iron Heads formed by hot-pressing; (B) One-piece Steel Tappet

An all-steel tappet is illustrated at *B*, this part being entirely produced from ½-inch round bar stock. The head is first upset to a diameter of about 1½ inches in a hot-heading machine and then hot-pressed to 2½ inches in diameter on a percussion press. The great variety of steel parts that can be manufactured by this process will be obvious from Fig. 3, which shows a collection made in Germany. An idea of the dimensions of these parts will be obtained by referring to the regular-size horseshoe slightly to the right of the center of the illustration. The large vertical hook is a coupling member for railway coaches.

Suitability of Percussion Press for Hot-pressing Process

There are a number of reasons why the percussion press is especially suited to hot-pressing parts in dies, one of them being that the pressure on the dies can be accurately controlled. The most important factor in its favor, however, is that the press will not become stalled if there is an excessive amount of metal in the slug, which is practically impossible to avoid, because of variations in the length of the slugs. Those familiar with the construction of the percussion press will remember that the ram is driven up and down through the medium of a large screw, at the upper end of which is mounted a flywheel. On the downward movement of the ram, the flywheel is driven from a vertical disk on the right-hand side of the machine, and on the return movement it is driven by a similar disk on the left-hand side, the right-hand disk being disengaged. Because, in the downward movement of the ram, the pulley starts its rotation when in a position close to the center of the disks and is near the periphery when the descent is ended, the flywheel and ram speed constantly increases to the point of striking the blow.

From this description it will be evident that the driving member does not pass over a dead center, and so there is no one point at which there is a tendency for the machine to stall. In a case where the machine cannot complete its stroke because of excess metal in the dies, the drive is reversed automatically without injury to the machine or tools. When an under-sized slug is placed in the die, the ram will over-run slightly and will reverse when the rated pressure has been applied to the slug. Dogs on a trip-rod provide for automatically reversing the ram at the end of the descent and for stopping it at the end of the ascent.

Tungsten steel is used for making the inside of the dies with which the work comes in contact, but this insert is backed up by one or more machine steel collars, it being too expensive to make the entire die from tungsten steel. The dies are usually made with automatic ejectors for removing the finished part. As metal shrinks in cooling, it is necessary to make the die cavities somewhat larger than the finished piece. No machining operation is necessary on the slugs before heating for die-pressing. A comprehensive description of the die-pressing of brass, bronze, aluminum, and nickel parts was published in the January, 1916, number of MACHINERY.

Fig. 3. Collection indicating the Large Variety of Steel Parts that may be hot-pressed

* * *

According to an investigation made by the National Industrial Conference Board covering wages and hours of employment in nearly 1700 factories during the month of October, 1923, the average weekly earnings of the employes in these factories had a purchasing power 32 per cent greater than in July, 1914. As the number of hours worked per week was less than in July, 1914, the purchasing power of the hourly earnings was still higher compared with July, 1914, and in the 1700 factories investigated, an hour's wage would buy 40 per cent more of the necessities of life than in July, 1914.

BELL METAL

Bell metal is a bronze containing either 80 per cent of copper and 20 per cent of tin, or 78 per cent of copper and 22 per cent of tin. As the name indicates, it is used for bells. Many attempts have been made to substitute cheaper metals for the copper and especially for the comparatively large percentage of tin, but these have proved unsuccessful, because good tones cannot be obtained from the alloy if not composed of the metals mentioned in the given proportions.

LOADS ON SOILS AND ROCKS

Information about the bearing capacities of soils and rocks is not only useful in structural engineering, but also of value under certain conditions in connection with the installation of very heavy machinery requiring foundations. The ultimate resistance of various soils and rocks will be given in tons per square foot: Natural earth that is solid and dry, 4 to 6 tons; thick beds of absolutely dry clay, 4 tons; thick beds of moderately dry clay, 2 tons; soft clay, 1 ton; gravel that is dry, coarse, and well packed, 6 to 8 tons; soft, friable rock and shales, 5 to 10 tons; sand that is compact, dry, and well cemented, 4 tons; natural sand in a clean dry condition, 2 to 4 tons; compact bed-rock, northern red sandstone, 20 tons; compact bed-rock, northern sound limestone, 25 tons; compact bed-rock granite, 30 tons.

SPONTANEOUS COMBUSTION

Spontaneous combustion or spontaneous ignition is a condition whereby a material ignites without having its temperature increased by applying heat from an external source. Coal, when stored in large quantities, is likely to ignite in this manner. Other substances that, under the right conditions, have been known to generate sufficient heat to cause spontaneous ignition are coke, lampblack, sawdust, charcoal, oily rags, cotton, flax, hemp, wool, oils, metallic powders, and dust of various kinds. Boiled linseed oil is the most dangerous of oils commonly used in industrial plants. Animal oils have but slight tendency toward spontaneous ignition, as compared with some of the vegetable oils which readily combine with the oxygen of the air. Mineral oils are not considered dangerous in this respect. The spontaneous ignition of oil-soaked rags or waste which has been left in a warm room or in the sun is among the more common occurrences of this kind. In this case ignition is caused by the rapid oxidation of the oil spread out over the large surface afforded by the threads in the waste or the folds of the cloth. As the result of this rapid oxidation, the temperature finally rises high enough to cause ignition.

PRIME MOVER

A prime mover may be defined as any machine which, by utilizing some of the forces of nature, produces power for the use of other machinery and devices. The principal prime movers are the steam engine and turbine, the gas and oil engine, the water turbine, and the windmill. The electric motor is not, strictly speaking, a prime mover, as it is driven by current obtained from a generator which, in turn, is driven by a prime mover. A prime mover may be defined briefly as a machine in which a natural form of energy is transformed into mechanical energy. The power from the prime mover is transmitted to the machine in which it is used for producing a given work, by some form of power transmission, which may either be mechanical, hydraulic, pneumatic, or electrical.

FROZEN CONCRETE

The freezing of concrete will not damage it, if it has first had a chance to set under favorable conditions for about two days. The effect of the freezing is simply to delay the process of hardening, which will again proceed under suitable conditions, and the concrete will eventually attain its full strength. If concrete is frozen before it has commenced to set firmly, it will not be injured, provided precautions are taken to prevent it from freezing again after it thaws until it is sufficiently hardened to withstand the effects of subsequent freezings. It is alternate freezing and thawing while setting that causes the damage. When concrete work is done in winter, it is necessary to devise means of mixing the concrete with materials freed of frost, placing it in the forms before it has commenced to freeze, and then protecting it and keeping it warm for about two days.

COINING PRESSURES

Special embossing or coining presses are required for many embossing operations in the manufacture of medals, jewelry, coins, silverware, etc. For such work as embossing coins or medals, enormous pressures are required in order to make the metal flow into every minute impression in the coining punch and die. The following pressures are required for embossing United States currency: Silver dollar, 160 tons; gold eagle, 110 tons; silver half-dollar, 98 tons; gold half-eagle, 60 tons; silver quarter-dollar, 60 tons; nickel, or five-cent piece, 60 tons; copper cent, 40 tons; dime, 35 tons. It will be noted that the gold half-eagle, silver quarter, and five-cent piece require the same pressure, although the sizes and weights differ greatly, thus indicating the comparative coining properties of gold, silver, and nickel.

SHUT HEIGHT OF PRESS

The term "shut height," as applied to power presses, indicates the die space when the slide is at the bottom of its stroke and the slide connection has been adjusted upward as far as possible. The "shut height" is the distance from the lower face of the slide, either to the top of the bed or to the top of the bolster plate, there being two methods of determining it; hence, this term should always be accompanied by a definition explaining its meaning. According to one press manufacturer, the safest plan is to define "shut height" as the distance from the top of the bolster to the bottom of the slide, with the stroke down and the adjustment up, because most dies are mounted on bolster plates of standard thickness, and a misunderstanding which results in providing too much die space is less serious than having insufficient die space. It is believed that the expression "shut height" was applied first to dies rather than to presses, the shut height of a die being the distance from the bottom of the lower section to the top of the upper section or punch, excluding the shank, and measured when the punch or upper section is in the lowest working position.

DUR-IRON

Dur-iron is a cast iron that contains approximately 12 per cent of silicon. Castings made from this material are used only for parts requiring high acid or corrosion resistance. The properties of dur-iron follow: Weight, 0.260 pound per cubic inch; 460 pounds per cubic foot. Specific gravity, 7. Strength in tension, 13,000 pounds per square inch. Melting point, 2190 degrees F.

PROPERTIES OF GOLD

Gold is the most malleable of all metals and is also extremely ductile. It may be beaten into leaves thin enough to transmit a greenish light, and one grain of gold has been drawn into wire 500 feet in length. One of the most remarkable properties of gold is that it is permanent in both moist and dry air at all temperatures, and that it is insoluble in all acids except in aqua regia (a mixture of hydrochloric and nitric acids) which will dissolve it. Chlorine and solutions that generate chlorine will dissolve gold. Pure gold is rarely used in the arts or industries, because of its softness, it being nearly as soft as lead and much softer than pure silver; it is, therefore, generally alloyed with either copper or silver. Gold coins and gold ornaments are always made of alloys of gold and copper, or gold, copper, and silver. The coins of the United States are composed of 9 parts of gold and 1 part of copper. The specific gravity of gold, when cast, varies from 18.3 to 19.35, but the specific gravity of pure gold obtained by precipitation may be anywhere from 19.55 to 20.7. Generally, the specific gravity of commercial gold is given as 19.3. The melting point of gold is 1063 degrees C. (1945 degrees F.). As a conductor of electricity, gold ranks next to silver and copper. Its electrical conductivity is equal to 76.7 (silver = 100).

ENGINE LATHE SIZE

The size of an engine lathe, according to the practice followed in the United States, is based upon the "swing" or the maximum diameter that can be rotated over the ways or shears of the bed. The nominal sizes listed by lathe manufacturers, however, ordinarily do not represent the maximum swing, but a diameter which is somewhat less. For instance, a lathe which is listed as a 24-inch size may actually swing 24½ or 25 inches. The variations between the nominal and actual sizes range from about ½ or ¾ inch up to 1½, or even 2 inches. According to the English practice, the size of a lathe is defined by the height of the centers above the top of the bed.

ALKALINE QUENCHING MEDIUMS

Alkaline solutions cool steel through the critical range or from the hardening temperature to the black stage at a slower rate than oil, which governs the hardness of the steel. In consequence, the use of alkaline solutions gives the least amount of hardness possible to the work when quenching in a liquid to the cold stage. The loss in hardness is compensated for by the toughness obtained and the elimination of the tendency to warp. When the hot steel is plunged into the bath, the "shock" or rapidity of cooling is so lessened that the case of the steel does not set with such hardness that the strains, etc., in the main bulk cannot bend it to a position of strain equilibrium. Alkaline baths are adaptable to treating steel parts such as axles, etc., when certain physical properties are desired. In case-hardening, alkaline solutions are well adapted for core refinement of delicate parts that would warp excessively if quenched in a faster cooling medium. Materials employed in preparing alkaline quenching solutions are lye, soda ash, soap, etc., and these are used in various amounts according to the final results desired. Alkaline solutions are not generally used, for the reason that, with the different grades of steels that can be obtained, a grade can almost always be selected that will give the desired physical properties by quenching in oil or water.

FORGE AIR PRESSURE

The air pressure for a forge commonly varies from 2 to 4 ounces per square inch, with an average of about 3 ounces. A pressure of 4 ounces at the blower has been recommended when the average number of fires does not exceed ten, and a pressure of 5 ounces when the number is more than twelve. Small forges with the blower close to them are adequately supplied with 1½ ounces pressure. If the blower is some distance away and a long discharge pipe with many bends leads to the forge, even though the latter be small, it may be necessary to carry 3 ounces pressure or more, to overcome the friction in the air ducts. The volume of free air required by the average forge fire is about 140 cubic feet per minute. The exhaust fan for a blacksmith shop should have a capacity approximately four times that of the forge blower, and should operate under a pressure of about ¾ ounce.

LIFE OF WOODEN POLES

The life of wooden poles for transmission lines varies according to the kind of wood, rapidity of growth, amount of sap at time of cutting, and seasoning after cutting. The following figures, based on a large number of observations, indicate the average life of untreated poles: Cedar, 13 to 14 years; chestnut, 11 to 12 years; cypress, 9 to 10 years; juniper, 8 to 9 years; pine, 6 to 7 years. Poles cut during the winter months when the sap is low always have a longer life than those cut in summer when the sap is up. The proper seasoning of poles also has a great influence on their life. They should be trimmed and peeled immediately after being cut, and should be supported on skids in separate layers for a period of from six months to a year, so that they will be thoroughly air-dried. It is now almost universal practice to give the butts of the poles and sometimes the cross-arms and tops a preservative treatment. Often the entire pole is treated. There are a number of different preservative materials that may be used. The principal of these is dead oil of coal tar or so-called "coal-tar creosote." This is a distillate obtained from coal tar at temperatures ranging from 400 to 750 degrees F. Coal tar itself is a distillate by-product obtained in the manufacture of coal gas and coke at temperatures of from 1500 to 3000 degrees F. Coal tar is of little use as a wood preservative, but the creosotes are of great value.

STAINLESS STEEL

The expression "stainless steel" has been applied to an alloy steel of high chromium content, which possesses to a remarkable degree the property of resisting corrosion. A typical analysis of this steel is as follows: Carbon, 0.28 per cent; silicon, 0.01 per cent; manganese, 0.12 per cent; chromium, 12.74 per cent; cobalt, 0.45 per cent; iron, 86.4 per cent. This steel was developed especially for use in the cutlery trades, because it neither rusts nor tarnishes when in contact with food and many fruit acids; hence the name "stainless." A 10 per cent sulphuric acid solution, however, attacks it. The elastic limit and the elongation vary according to the heat-treatment. The elastic limit of the forged steel varies from 60,000 to 70,000 pounds per square inch and the ultimate strength from 95,000 to 110,000 pounds per square inch. When annealed, the elongation may be as high as 27 per cent in two inches, with a reduction in area of 50 per cent. The Brinell ball hardness test of the annealed material is 185. The steel requires considerable care in forging and rolling.

Around the Shop with the "Electric Mule"

How the Transporting of Materials from One Department of a Plant to Another has been Speeded up by the Use of Lift Trucks and Tractors

By H. S. RIGGS
The Lodge & Shipley Machine Tool Co.
Cincinnati, Ohio

A GOOD system of transporting materials to and from the various departments is the keynote of the successful shop, but it is usually only when the system does not run smoothly that its true value is learned. This article describes the trucking system of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, which has been developed to a point where it is a real asset. It has brought a greater unity between departments, in addition to increasing production. After experimenting a number of years, this concern adopted the plan of using special platforms and trays such as shown in Fig. 2, which can be built up to any height for use with lift trucks. The corners of each platform are supported by cast-iron feet which are fastened in place by eight screws each. The feet extend ¾ inch above the floor of the platform to provide solid right-angle corners into which the tray is easily fitted. The corners of the trays are similar, so they can be stacked with security to a good height. The dimensions of the platform and the trays are given in Figs. 1 and 4, respectively.

For all light loads to be hauled only a short distance, the platform is carried on an elevating truck pulled by hand, but when there is a heavy job or even when light work must be conveyed a considerable distance, a three-wheeled storage battery tractor or "electric mule," as it is commonly called, is used as shown in the heading illustration, for pulling one or more lift trucks on which a platform is carried. These platforms are made to carry unusually heavy weights, and an "electric mule" hauling two elevating trucks coupled together, each carrying a load of nearly a ton, is a common sight in this shop.

In a large plant such as this, which includes a number of buildings having a total floor space of over 200,000 square feet, the importance of keeping material moving speedily so that each department has sufficient work cannot be over-emphasized. A number of these tractors are kept constantly going around the shop, calling at intervals at each department for trays of work to be moved to the next department as indicated on a traveler tag which accompanies each job. To the traveler tag is attached a blueprint of the job.

Use of Traveler Tags

This traveler or "follower" tag, as it is sometimes called, is made out, as shown in the lower view, Fig. 3, for each lot of parts to be run through the shop. The routing department designates on this tag the departments that will have work to do on this lot of parts, and gives the names of the departments in the sequence of the operations. From the raw stores, the stock is taken by a tractor to the receiving station of the first department called for on the tag. In the meantime, the foreman of this department has received a shop "tickler" of the type shown at the top in Fig. 3. This slip has information on it about the job, and the date of its issue is stamped in big figures so that the foreman will put the jobs through in the sequence in which they are received and not give any particular one preference unless specially instructed to do so. These ticklers are posted conspicuously on a board over the foreman's desk to remind him continually of the older jobs. This has been found to be an excellent means of keeping the work moving through the shop in the sequence originally planned.

Just as soon as a workman's time ticket for the job is turned in to the works office, a tickler is sent to the next department noted on the traveler tag and the old one is destroyed. In this way each foreman knows just what work is planned for his department.

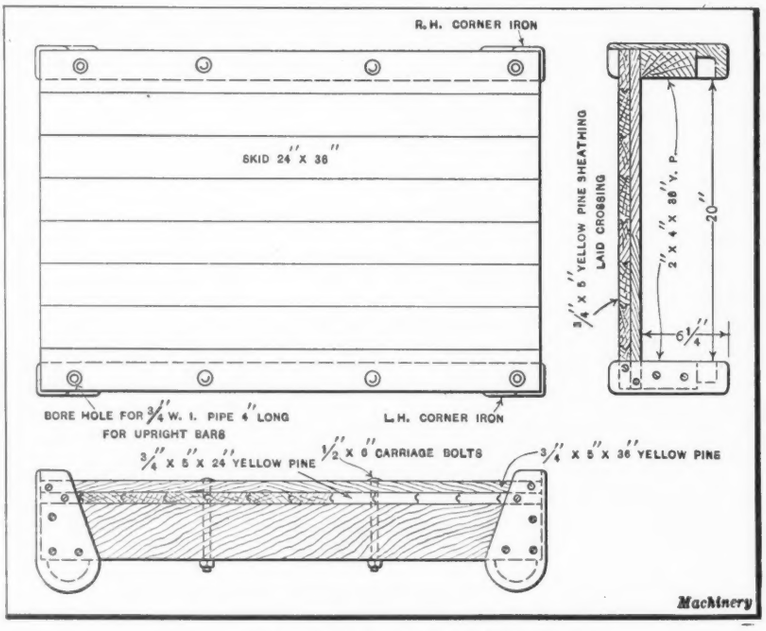

R.H. CORNER IRON
SKID 24" X 36"
3/4" X 6" YELLOW PINE SHEATHING LAID CROSSING
2" X 4" X 88" V. P.
20"
6 1/4"
BORE HOLE FOR 3/4" W. I. PIPE 4" LONG FOR UPRIGHT BARS
L.H. CORNER IRON
3/4" X 5" X 24" YELLOW PINE
1/2" X 6" CARRIAGE BOLTS
3/4" X 5" X 36" YELLOW PINE
Machinery

Fig. 1. Working Drawing of the Trucking Platform

Fig. 2. Portable Platform and Tray which can be stacked for holding Various Quantities of Work

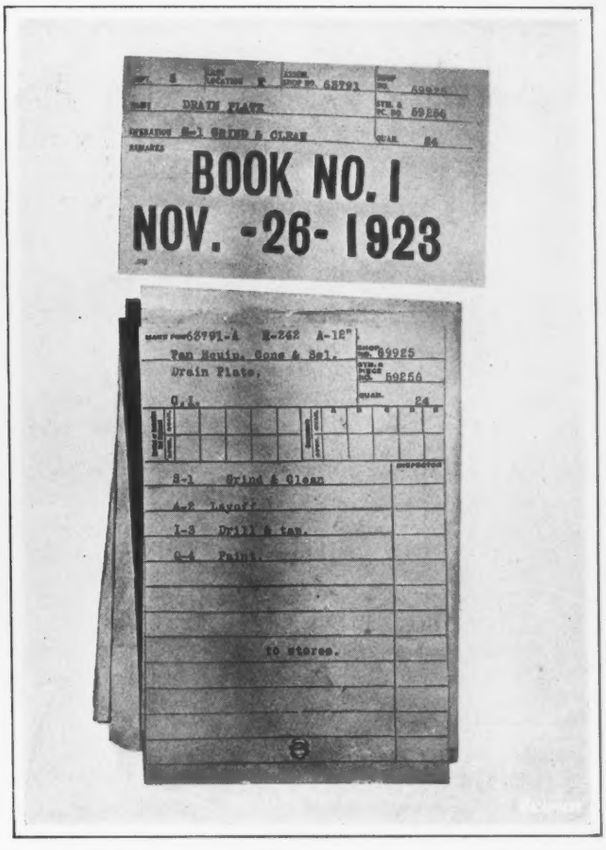


Fig. 3. Typical Shop "Tickler" sent to the Foremen, and Traveler Tag which accompanies the Work

When a lot of parts is completed by one department, the platforms on which the work has been placed are hauled by means of an elevating hand truck to the "move" station. This station is marked off with a wide white line, as shown in Fig. 5, and anything put into it is ready for removal to the next department called for on the traveler tag. The platforms are taken from this station to the various departments by means of tractors.

Before the job is taken to the receiving station of the next department specified, it is taken to the inspection department. When the parts have been inspected, the traveler tag is punched accordingly, and the platforms are put into the move station of this department. The inspecting of work after each department has finished with it, has proved to be invaluable, as it saves work being done by the next department on parts that are defective.

Each department is identified by a metal sign about two feet square, on which a red letter is painted on a yellow background. This sign hangs in a conspicuous position, and when the trucker unloads a box he rechecks the letter specified on the traveler tag against the letter on the sign in the department to which he has just transported the job. A white sign or "flag" placed on any box, as shown on the third box from the front in Fig. 5, signifies that that particular job is in a rush, and the trucker gives it preference in delivering. When a job is in a particular hurry, the foreman makes a trucker's "auto-call," and instructs him to haul the work immediately. In this system, numbers are given to all the men in the shop who move about considerably and who may be wanted at any time. The "auto-call," is operated from the telephone switchboard, and the number of the man wanted is rung by bells located throughout the plant. When a man hears his number rung, he calls the telephone operator to find out where he is needed and what is wanted.

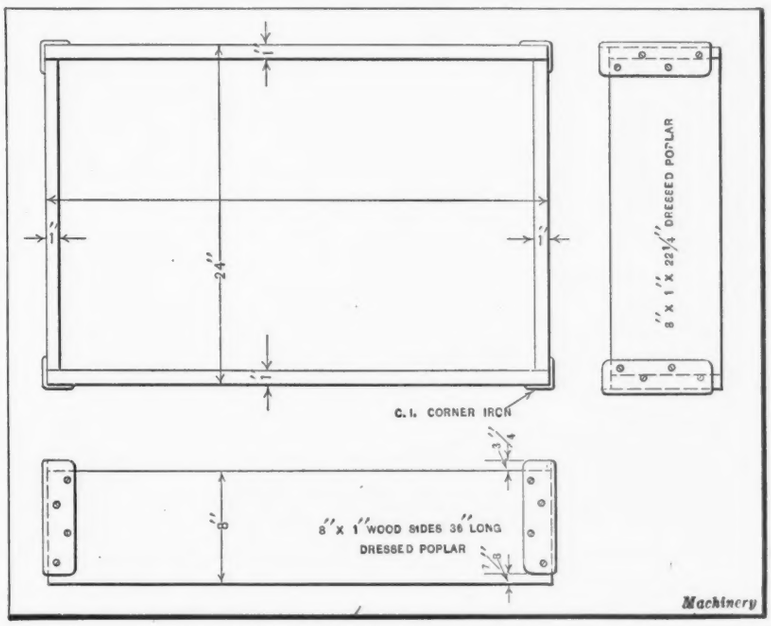


Fig. 4. Details of Tray used with Platform shown in Fig. 1

For handling such work as lathe spindles, it has been found more satisfactory to mount a substantial rack right on the truck platform, as shown in Fig. 6. This rack is hauled from one department to another, and the spindle is replaced after each operation. When the job is completed, the loaded rack is put into the stock-room, where the parts are kept together until the headstocks for which these partic-

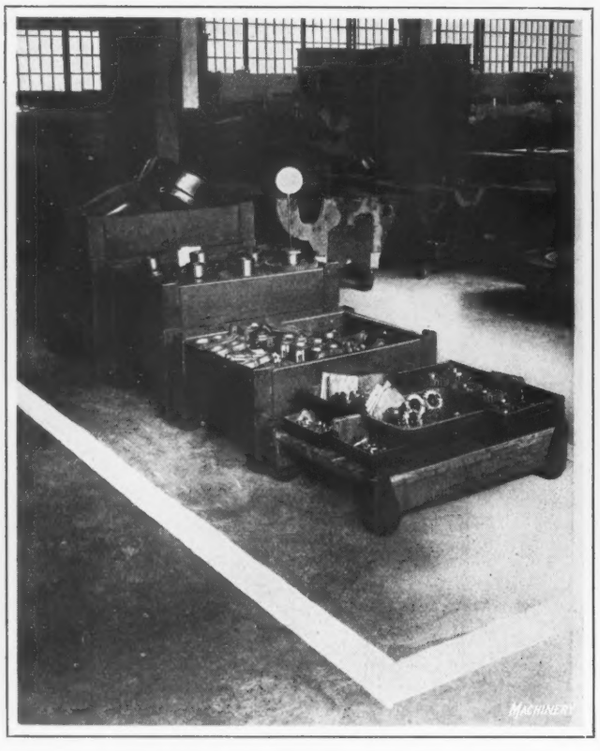


Fig. 5. A "Move" Station in which Work is placed for Transportation to the Next Department

Fig. 6. Special Rack on which Lathe Spindles are placed to lessen the Danger of Damage in transporting them

ular spindles are intended have been constructed. The empty rack is then returned to the raw stores department. This method not only means a minimum handling and a considerable saving in time, but also insures that the spindles will be handled and put into stock with much less danger of damage.

Special Rack, Assembling Platforms, and Portable Vise Benches

Such work as small pinions and stems, or other jobs that are difficult to pile and might easily be marred or battered if thrown into a box, are transported in a special box provided with holes bored to permit vertical stacking, as illustrated in Fig. 7. A system has been worked out whereby one box can be stacked on another with the stems from the lower box protruding through the bottom of the box placed on top. The work is taken through the various departments and kept in the stock-room in this special box.

All large headstocks are assembled directly on platforms, as shown in Fig. 8, and sent into the stock-room in this way. This method has a number of advantages: in the first place, it obviates having to lift the large massive heads, with the resultant danger to the workmen, and furthermore, the job can be taken to the tools and moved freely about in the department when it is mounted in this manner.

The portable vise bench seen in Fig. 9 is another convenience that is a part of the transportation system. The tools are kept in a swinging drawer underneath the top of the bench. The vise is fully as rigid as if bolted to a stationary bench because of the solid construction of the equipment. When one assembly department needs additional vises, as is sometimes the case, these portable benches can be quickly taken to that department.

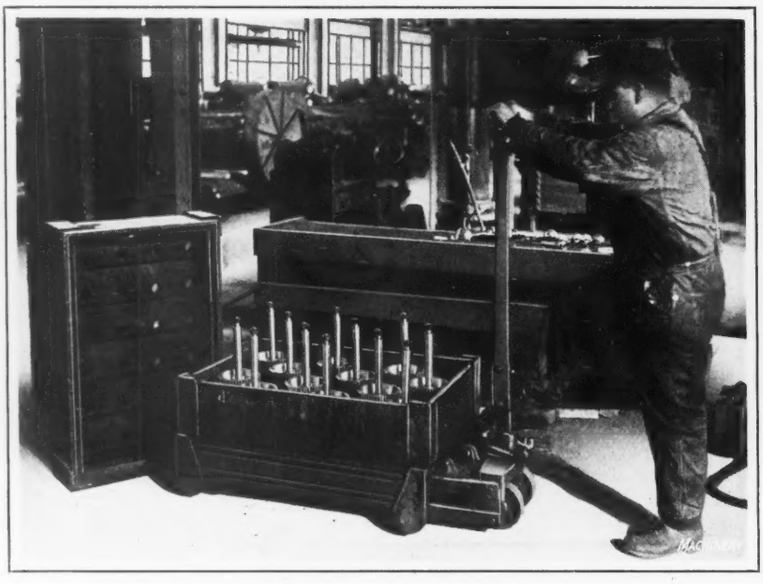


Fig. 7. Another Special Rack in which Work is held Upright

Conclusion

Not only are the electric tractors useful in transporting production work, but they are also of inestimable value in doing odd jobs about the plant. In some departments there is a shortage of space, and in that case, the value of stacking the trays is particularly apparent. Three-wheeled tractors are used because of the fact that this type can be turned around in a small space even when trailing one or two platforms, as will be seen by reference to the heading illustration.

Certain rules govern the use of platforms in this shop: for instance, no empty platforms are permitted to be set in a receiving station of any department unless they are intended to be used for hauling pans of work. A number of different sized pans are used, as seen in Fig. 5, for lots of small parts. These parts are kept in the pans in each department and finally stored in them in the stock-room. Platforms must always be kept working, and when a plat-

form is unloaded it is sent immediately to the raw stores department.

While conveyor systems offer a solution in some factories to the problem of transporting work, in the plant considered in this article the system of hauling by the use of "electric mules," trucks, and portable platforms, boxes, racks, and benches has been found to be best. Before this system was installed, the expense of employing hand truckers was enormous as compared to present costs. The force of truckers was decreased 75 per cent after the installation of the tractors. In addition to these economies, work is now kept flowing more smoothly through the plant, and this, in itself, makes the system a sound paying investment, besides promoting a better feeling among the workmen.

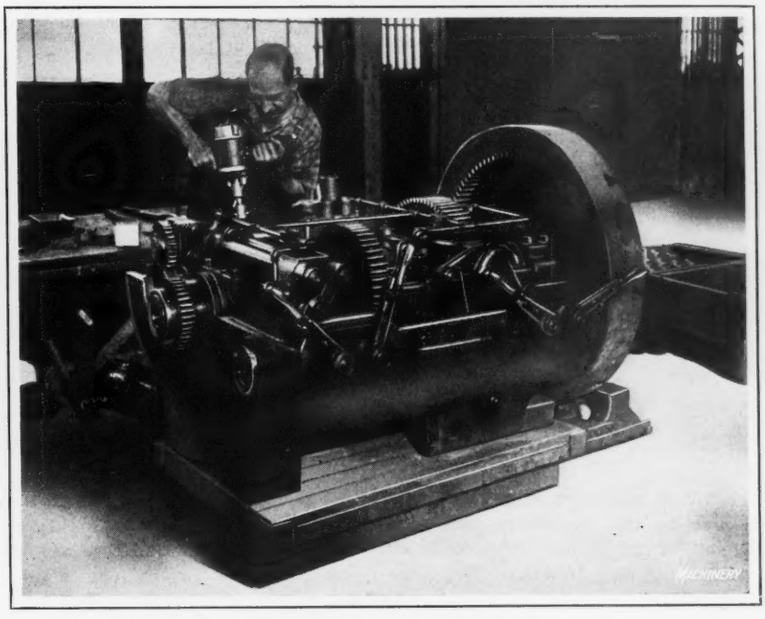


Fig. 8. Large Lathe Headstock assembled on Platform for Convenience in moving about

* * *

IMPORTANCE OF STATING TOLERANCES

By N. G. NEAR

The importance of having machining tolerances clearly stated in contracts for building machinery or machine parts cannot be over-emphasized. A job was recently completed at the plant where the writer was employed which brought this point forcibly to mind. The work was finished in good faith in accordance with the blueprints submitted by the customer. Unfortunately for the customer, however, nothing was said about tolerances, the dimensions on the blueprint being simply given as 2.5 inches, 2¼ inches, 3.25 inches, etc. It was accordingly assumed that it was the intention of the customer that the machine builder exercise his judgment in determining what tolerances to work to.

After the job was completed and delivered, it was found that the dimensions were in most cases 0.0005 inch too large. This rendered the work useless, so the customer informed the builder that the work would be returned, as it was not accurate enough, and stated that he would not pay for the job. Upon discussing the matter, the customer was obliged to admit that he was at fault because he did not specify the desired tolerances, but the manufacturer realized that he would probably not be able to compel the customer to pay for the job, even though he was at fault in not specifying the desired tolerances. The manufacturer then explained to the customer that where accurate work is required, dimensions are usually placed on the drawings in the following manner: 2.5 inches, ± 0.001.

Fig. 9. Portable Vise Benches used in Assembling Departments

It is certainly important to mark blueprints carefully in this manner so that there can be no question as to the exact size desired. It is much more satisfactory to work to dimensions like these than to be given rough dimensions, such as 3½ inches or ½ inch, without any indication of the accuracy required. If, for example, a dimension is given as 2.500 inches instead of 2.5 inches, it means that the work must at least be accurate to plus or minus a thousandth of an inch; that is, a machinist may make the work larger than 2.500 up to 2.501 or smaller down to 2.499 inches.

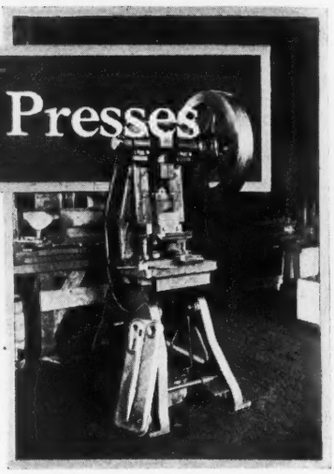
If the dimension is given as 2.50 inch, it must be accurate to within a hundredth of an inch. The best method of all, however, is to give the actual tolerance and thus do away with all guesswork. Usually when a fraction is given roughly, as, for instance, ½, ¼, ¾ inch, the average machinist infers that the dimensions are not of great importance and that micrometer accuracy is not necessary. Thus if a customer carelessly gives dimensions in this rough manner, the blame for any slight inaccuracy certainly should rest on his own shoulders and not on the machinist.

* * *

READABLE CIRCULARS

The main object in preparing advertising circulars and catalogues should be to so present the information that the selling arguments and descriptions will be read. In order to accomplish this end, it is important that the type and its arrangement be so chosen that the matter may be easily read, leaving the mind free to concentrate wholly upon the contents of the printed message. A long line is difficult to read, and if circulars are letter-size and set in ordinary 8-point type, it is advisable that they be set in two columns, rather than entirely across the page; for example, a line 7 inches long, set in the same type as that in which MACHINERY is printed, is difficult to read, whereas the same type set in two columns, each being approximately 3¼ inches wide with ample space between, makes comparatively easy reading. The mistake of using too long a line is perhaps more commonly made in the preparation of circulars than anywhere else. The length of the line should be chosen with regard to the size of the type. Very large type, of course, permits the use of a longer line.

Design of Inclinable Power Presses



Proportioning a Mechanical Knock-out, the Legs, and the Inclining Mechanism for a Power Press

By P. A. FRIEDELL

INCLINABLE presses should be equipped with a mechanical knock-out in the slide, as this facilitates many die operations, especially such combination operations as blanking and piercing or blanking and drawing. The common form of slide knock-out for inclinable presses, as shown in Fig. 1, is composed of a steel bar A which extends through a cored hole B in the slide. Toward the end of the up stroke, set-screws V stop the motion of bar A. A pin C extending up through the stem of the punch actuates the stripper when the bar is stopped.

The minimum dimension X of bar A may be computed by the formula

$$X = 0.196 \sqrt[3]{ZP}$$

in which Z = distance between set-screws V, and P = capacity of press, in tons.

Before this formula can be solved, it is necessary to determine dimension Z and assume a value for P; the latter will be assumed as 50 tons. Thus,

$$V = 0.1d + 0.125 \text{ inch}$$

in which d represents the diameter of the crankshaft at the main bearings, which will be assumed to be 4⅜ inches.

Then

$$V = (0.1 \times 4.375) + 0.125 = 0.5625 \text{ or, say, } \tfrac{5}{8} \text{ inch}$$

and

$$Z = Y + 2V + 0.25 \text{ inch}$$

Assuming that $Y = 12\frac{1}{2}$ inches, then

$$Z = 12.5 + (2 \times 0.625) + 0.25 = 14 \text{ inches.}$$

Dimension W should be ⅛ inch narrower than the slot provided for bar A through the slide. It will be assumed that $W = \frac{7}{8}$ inch. Substituting the known values in the formula for X,

$$X = 0.196 \sqrt[3]{14 \times 50} = 1.740, \text{ or } 1\tfrac{3}{4} \text{ inches}$$

The height of slot B should be about $X + 1$ inch = $1\frac{3}{4} + 1 = 2\frac{3}{4}$ inches. Dimension E depends upon the design of the slide. The knock-out bracket may be held by one of the gib studs, and located by a dowel at the opposite end of the bracket as shown. Pins F should be driven into bar A to keep it in the proper location, leaving about ⅛ inch total clearance between them and the slide.

Developing the Legs

No definite rules can be given for calculating the thickness of any section of the legs of a power press, as there are great variations in the height and length of the leg as well as in the weight of the press, all of which must necessarily be taken into consideration in calculations covering any section. It is therefore customary to lay out the press proper and design the legs to give the best and most uniform appearance, making the cross-sections of such dimensions as have been found by experience to be suitable. Fig. 2 shows a typical leg design for an inclinable press. In designing the leg, it will be assumed that the web thickness E is ⅝ inch and the bolt of diameter V, 1¾ inches. Then

$$F = 2V = 2 \times 1.75 = 3.5 \text{ inches}$$

The front of the leg may be tapered forward from top to bottom, about 1 inch per foot, while the rear edge may be tapered to make angle A from 45 degrees for low legs to 60 degrees for high legs. The outer surface of the leg may be tapered ¾ inch per foot as shown, and the inside, 1¼ inches per foot. These tapers give the leg a sturdy appearance.

$$U = 2V + \tfrac{1}{2} \text{ inch} = (2 \times 1.75) + 0.5 = 4 \text{ inches}$$

Centers a and a_1 of the frame should be laid out approximately 45 degrees each side of the center c, (see also Fig. 3) from which they are struck, and at radius R from center c.

$$R = R_1 - \frac{U}{2}$$

Assuming R_1 to be 21⅛ inches,

$$R = 21.125 - 2 = 19.125 \text{ inches}$$

Center b, Fig. 3, should be located within a few inches of the edge of the plate, between the housings—in the present case, say 4 inches.

To find the maximum adjustment, strike radius J through point c with a as a center, and then lay off point k at a distance B from line e, dimension B being equal to R_1. By the use of a protractor, angle f, between lines ac and ak, is found in the present case to be 24 degrees. With k as a center, next strike an arc of radius R_1. This arc gives the position of the lower part of the frame at the lowest point of inclination. Next lay out angles f, from lines ab and aa_1. To locate center g of the boss for the inclining screw crossbar, strike an arc of radius K with a as a center through b, placing the center g a horizontal distance from point b equal to one-half the height of the arc. Dimension G should be about 5½ inches. Next lay out the horizontal center line at g to make the boss clear the lower edge of the frame as described by radius R_1. It will be assumed that $H = 8\frac{1}{4}$ inches.

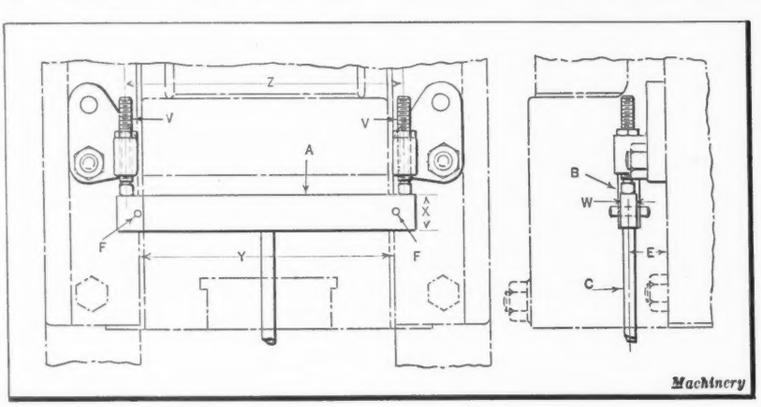


Fig. 1. Typical Mechanical Knock-out for operating a Punch Stripper

The hole in the boss is usually cored, although it is sometimes machined to receive the pivotal end of the inclining screw cross-bar. Distance M will be found from a lay-out to be 23 inches. Holes i, Fig. 2, are provided to receive two rods, the purpose of which is to tie the two legs rigidly together. These rods may be made the same diameter as the main-bearing cap studs and tied in place by using a nut on both sides of each leg. Other dimensions are found as follows:

$O = 1.414R = 1.414 \times 19.125$
$= 27.043$, say 27 1/32 inches

$L = 2E = 2 \times \frac{5}{8} = 1\frac{1}{4}$ inches

Assuming height P from the floor to the top of the bed to be 34 inches, then

$$Q = P - 0.707R = 34 - (0.707 \times 19.125)$$
$$= 20.477, \text{ or } 20\tfrac{1}{2} \text{ inches}$$

Angle f should be made 30 degrees when possible, though it is controlled by various factors. Usually an inclination of from 15 to 20 degrees is sufficient to cause parts to slide by gravity from the die. Center line t of the clutch rod (Fig. 3) should be placed so as to clear the heavy section of the gap, say about 2 inches back of this section.

The treadle should preferably be made of machine steel, from $\frac{3}{8}$ to $\frac{5}{8}$ inch thick, and from $1\frac{1}{2}$ to $2\frac{1}{4}$ inches wide, according to the size of the press. A foot-pad may be welded or bolted to the treadle, or the bar may be twisted through 90 degrees so as to present the broad side of the bar in a horizontal plane. A spring should be furnished for raising the treadle when pressure is removed from it, and a boss is provided at h (Fig. 2) for a spring hook. Considering a treadle pad 4 inches long extending entirely beyond the front of the leg, the length T (Fig. 3) equals about 28 inches. The ratio of length S of the treadle to length W of the treadle lever should be approximately 5 to 1. Then

$$S = 28 \times \frac{5}{4} = 35 \text{ inches}$$

and

$$W = S \div 5 = 35 \div 5 = 7 \text{ inches}$$

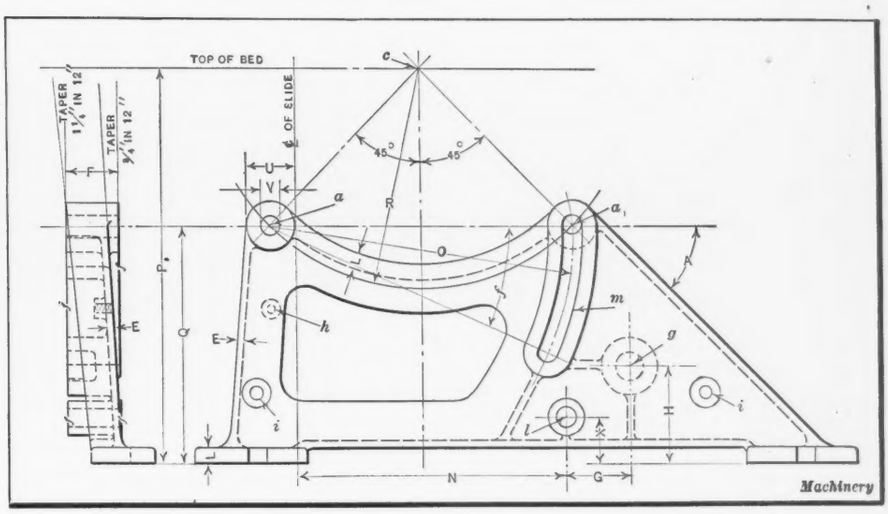


Fig. 2. Design of Leg for an Inclinable Power Press

Assuming a distance of 17 inches from the center line of the slide to the center line t of the clutch rod, dimension $N = 17 + 7 = 24$ inches. Height X of the treadle center line above the floor should be approximately 4 inches. It is customary to make the treadle shaft about $1\frac{1}{4}$ inches in diameter, except on small presses, when it is made slightly less. Dimension Y should be made about twice the thickness of the frame web. Assuming this thickness to be $1\frac{3}{8}$ inches, Y equals $2\frac{3}{4}$ inches. The leg may be cast solid in low patterns, or may be cored as shown in Fig. 2. Slot m may be cored about $\frac{1}{8}$ inch over-size.

Designing the Inclining Attachment

The inclining attachment shown in Fig. 4 is now commonly used on inclinable presses, having almost entirely supplanted the former rack and pinion and other types. Acme or square threads are generally used on the inclining screw, the upper end of which is pivoted. A threaded handwheel or nut is used for operating the attachment, and should be designed in such a manner that it will be impossible to adjust the handwheel when studs V, which hold the frame in position on the legs, are clamped tight. This condition is provided for in the attachment illustrated by having lugs of thickness K seat over a collar of thickness N on the handwheel.

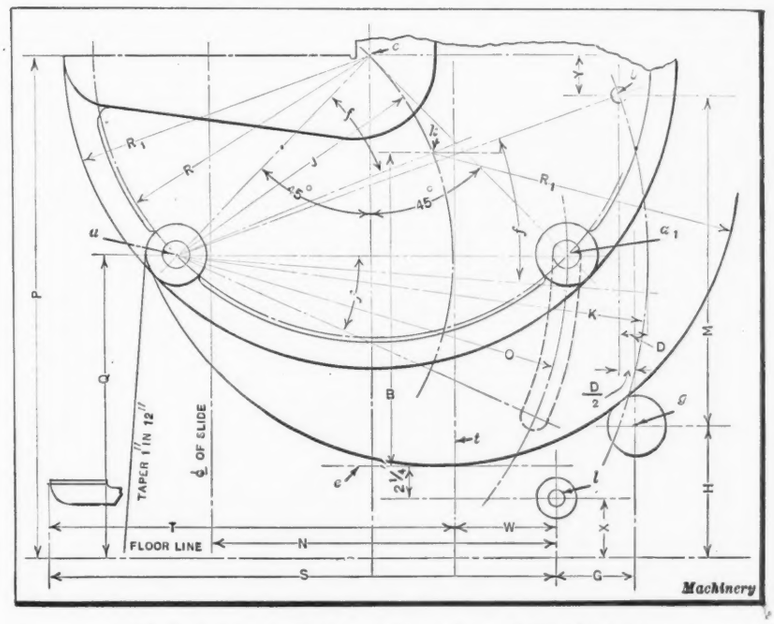


Fig. 3. Lay-out involved in developing the Inclining Attachment

The diameter of the inclining screw and the cross-section of the cross-bar A must be calculated from the approximate weight of the press, including the die. It will be assumed that this weight is 6000 pounds. Length M of the inclining screw from the center of the pin to the center of the cross-bar was found to be 23 inches in proportioning the legs. The required root diameter d of the inclining screw may then be calculated.

If P = ultimate load, in pounds, on screw,
M = length of inclining screw from center of pin to center of cross-bar, and
R = radius of gyration, then

$$P = 50{,}000 \div \left(1 + \frac{M^2}{18{,}000R^2}\right)$$

or, for a round section,

$$P = 50{,}000 \div \left(1 + \frac{M^2}{1125d^2}\right)$$

Assuming d to be 1 inch,

$$P = 50{,}000 \div \left(1 + \frac{23^2}{1125 \times 1^2}\right) = 34{,}000$$

$$\text{Safe load} = \frac{PA}{F}$$

in which A = area of section, $= 0.7854d^2$ and
F = factor of safety—assume 4.

Then,

$$\text{Safe load} = \frac{34{,}000 \times 1^2 \times 0.7854}{4} = 6675 \text{ pounds}$$

As the weight to be supported was found to be only 6000 pounds, this safe load is sufficient. Assuming 4 square threads per inch, the outside diameter S of the screw would be 1¼ inches.

Calculations for the Cross-bar

Distance L between bosses g, for purposes of calculation, may be considered the same as the distance between the outer faces of the main bearings of the press, say 27 inches. The inclining screw cross-bar must be designed to carry a load of 6000 pounds concentrated at the center. The bending moment $= \frac{6000 \times 27}{4} = 40{,}500$ inch-pounds. Assuming a stress of 3000 pounds in tension and compression, the required section modulus $= \frac{40{,}500}{3000} = 13.5$.

The cross-bar section shown at X may be incorporated in heavy presses, while in lighter presses, a rectangular or circular section may be employed. Considering the I-section shown, the width and thickness of the flanges and the thickness of the web may be standardized so as to simplify calculations. Then dimensions T will be made the same as the diameter of the cored hole through the cross-bar for receiving the inclining screw, or

$$T = 1.25 + 0.125 = 1.375, \text{ or } 1\tfrac{3}{8} \text{ inches}$$

For a cross-bar of rectangular section, where W = width of beam $= 0.5H$, H = depth of beam, and $\frac{I}{C}$ = section modulus:

$$H = \sqrt[3]{12 \times \frac{I}{C}} = \sqrt[3]{12 \times 13.5} = 5.45, \text{ or } 5\tfrac{1}{2} \text{ inches}$$

$$W = \frac{5.5}{2} = 2.75, \text{ or } 2\tfrac{3}{4} \text{ inches}$$

At the center, where the inclining screw passes through the bar, the width would equal 2.75 + 1.375 = 4.125, or 4⅛ inches.

For a cross-bar of circular section,

$$d = \sqrt[3]{\frac{I}{C} \div 0.098} = \sqrt[3]{\frac{13.5}{0.098}} = 5.165, \text{ or } 5\ 3/16 \text{ inches}$$

The section modulus of the section shown in Fig. 4, assuming that $W = 3T$, may be found by the formula

$$\frac{I}{C} = \frac{3TH^3 - (H - 2T)^3 \times 2T}{6H} = \frac{T\,[3H^3 - 2(H - 2T)^3]}{6H}$$

Inserting the known values, and assuming a value of 5 inches for H,

$$\frac{I}{C} = \frac{1.375\,[(3 \times 5^3) - 2\,(5 - 2.75)^3]}{6 \times 5} = 16.143$$

$$\text{The fiber stress} = \frac{40{,}500}{16.143} = 2508 \text{ pounds per square inch.}$$

This section would be satisfactory, but it is heavier than required. Therefore, assuming a value of 4.5 inches for H and recalculating,

$$\frac{I}{C} = \frac{1.375\,[(3 \times 4.5^3) - 2\,(4.5 - 2.75)^3]}{6 \times 4.5} = 13.37$$

which is close to the required section modulus.

As the ends of the bar are not machined and fit loosely into the cored holes in the legs, they may be computed as cantilever beams loaded at the end with half the weight of the press. If the length of each end is assumed as 1 inch, the bending moment = 3000 × 1 = 3000 inch-pounds. Thus, the required section modulus for the bar ends $= \frac{3000}{3000} = 1$, and as the section modulus for a round section $= 0.098d^3$,

$$D = \sqrt[3]{\frac{1}{0.098}} = 2.16, \text{ or } 2\tfrac{1}{4} \text{ inches}$$

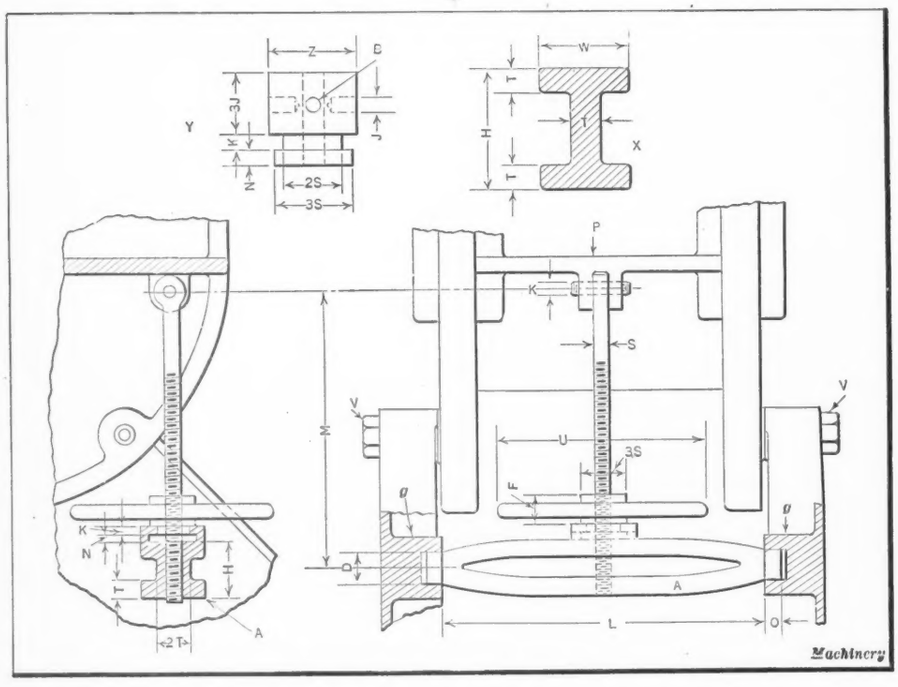


Fig. 4. Inclining Mechanism commonly seen in Power Press Construction

Also,

$$F = 2S = 2 \times 1.25 = 2.5 \text{ inches}$$

and

$$K \text{ and } N = \frac{S}{2} = \frac{1.25}{2} = 0.625, \text{ or } \tfrac{5}{8} \text{ inch}$$

Proportioning the Handwheel and Nut

The handwheel should be made of a size that will require no undue effort for its operation. Assuming a maximum force of 40 pounds at the periphery of the handwheel, diameter U may be obtained from the formula,

$$U = \frac{2P_1 r\,[p + (6.2832ur)]}{F\,[(6.2832r) - (up)]}$$

in which

P_1 = weight of press;
F = maximum force exerted at rim of handwheel;
r = pitch radius of screw;
p = lead of thread; and
u = coefficient of friction.

As the screw is readily oiled, and the friction surfaces are steel and cast iron, the coefficient of friction u may be taken as 0.05. Substituting the known values in the foregoing formula,

$$U = \frac{2 \times 6000 \times 0.5625 \times 0.25 + (6.2832 \times 0.05 \times 0.5625)}{40 \times [(6.2832 \times 0.5625) - (0.05 \times 0.25)]} = 20 \text{ inches}$$

approximately.

This diameter would be slightly too large, as will be observed from the drawing; 18 inches would be about the largest diameter that could conveniently be used.

A nut, such as shown at *Y*, requiring a removable bar or a reversible wrench for operating it, may be provided instead of the handwheel. The approximate bending moment M on an operating bar or wrench that extends 10 inches from the center line of the screw equals 40 × 10 or 400 inch-pounds. From this the required diameter d of the bar may be found as follows:

$$d = \sqrt[3]{\frac{M}{1500}} = \sqrt[3]{\frac{400}{1500}} = 0.643 \text{ or } \tfrac{5}{8} \text{ inch}$$

Therefore, diameter J of holes B should be a slip fit for the bar. The depth of the holes should be about $1.5J = 1.5 \times 0.625 = 0.937$, or 15/16 inch. Diameter $Z = 4J + S = (4 \times 0.625) + 1.25 = 3.75$, or 3¾ inches. Then the actual bending moment on the nut-operating bar = 40 × (10 — 1.875) = 325 inch-pounds.

$$\text{Section modulus } \frac{I}{C} = 0.098 \times 0.625^3 = 0.0239$$

$$\text{The fiber stress} = \frac{325}{0.0239} = 13{,}600 \text{ pounds per square inch}$$

As the bar is usually subjected to a jerking action instead of a steady pull, the fiber stress value obtained in the calculation will prove satisfactory. A fiber stress of 16,000 pounds per square inch should not be exceeded for machine steel. In calculating the diameter of the bar, it is important to make the bar holes of sufficient size and to allow sufficient stock on the nut to permit a good hole depth.

Treadle or Clutch Rods

The treadle or clutch rods must be designed in such a manner as to allow for the required variation in length when the press is inclined. They may be made of from ⅜- to ⅝-inch round steel, according to the size of the press. The usual method is to make the rod in two parts, and provide two clamps for fastening the parts together. It is necessary to loosen the clamps before operating the inclining attachment.

* * *

The Federal Board of Vocational Education has recently published a bulletin on apprentice education. Surprising progress has been made along the lines of part-time apprentice training classes organized by the public schools in several states. On June 30, 1922, there were 265,000 pupils enrolled in such continuation classes. All these pupils did not serve regular apprenticeships, but they attended continuation classes while regularly employed in the industries.

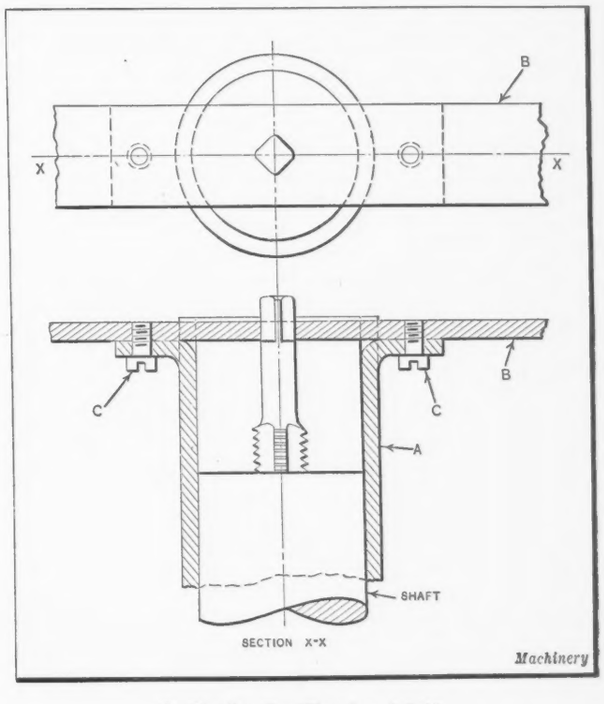
A definite issue is taken with the belief of many educators that the part-time school is only a temporary makeshift, to be displaced as soon as the age of compulsory full-time education can be raised to the desired point. The bulletin questions the wisdom of full-time education for boys and girls over fourteen years of age whose minds are set on employment. For such youths, industrial experience will prove of greater educational value than unwilling attendance at high schools. At the same time, the part-time school holds these young workers within the influence of the public school system. Copies of this bulletin are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C.

TAP GUIDE FOR SHAFT ENDS

By HARRY MOORE

The combination tap wrench and guide shown in the accompanying illustration provides a simple means of insuring accurate alignment of the tap while tapping a hole in the end of a shaft. The complete device consists of a piece of steel tubing *A* which is a snug fit on the shaft to be tapped, a length of flat steel *B*, and the assembling screws *C*. The flat steel piece *B* having a squared hole in the center that fits the square end of the tap forms the tap wrench and is joined permanently to the tube *A* by the screws *C*.

After obtaining the materials for the device, two saw cuts are taken across the top of the tube and the pieces of metal between these two slots are bent back on opposite sides to form lugs. The piece *B* is then placed in position with the square hole in the center in alignment with the center of the tube. These two parts are clamped together and the holes drilled for the screws *C*. The method of



Combination Tap Wrench and Guide

employing the wrench should be clearly understood from an inspection of the illustration. The tube *A* must, of course, be a good fit on the shaft and long enough to form a good bearing on the shaft before the tap begins to cut. The tap guide described is not used merely in starting the tap, but also for the complete operation of tapping the hole to its full depth. This guide does not interfere with the chips, as is often the case when bushings are used to guide the tap.

* * *

MACHINERY EXPORTS

In an article by W. H. Rastall, chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, recently published in *Commerce Reports*, it is mentioned that in 1921, out of the total amount of metal-working machinery produced, 22.2 per cent was exported. The highest ratio of exports to production was in dredging and excavating machinery, where over 45 per cent was sent abroad; 41 per cent of the oil-well machinery built was exported, and 25 per cent of the mining machinery. About 25 per cent of the air compressors made were exported. The exports of textile machinery amounted to about 15 per cent, and of woodworking machinery, approximately 14 per cent.

Interlocking Devices

First of Three Articles Describing Different Types of Interlocking Devices

By ALBERT CLEGG

THE primary purpose of an interlocking device is to prevent the simultaneous engagement of conflicting mechanisms, so as to eliminate, as far as possible, the danger of straining or breaking any of the machine parts. There are many examples of interlocking devices in which the component parts are much more costly to produce than is necessary or justifiable, considering the function of the device. Granted that its purpose is to protect expensive parts of the machine from destruction, there is seldom any need to provide other than the simplest mechanism to accomplish the desired end. Elaboration or complication in this connection is unnecessary, and should be guarded against.

A separate movement should not be required to lock or unlock such a device, but the ordinary manipulation of the parts controlled by the interlocking mechanism should, without any further effort, insure the correct functioning of the safety device. Otherwise, the operative time will be increased so that there will be much less available time for productive work. Over-elaboration in design as well as a tendency to make the parts much stronger than is necessary should be avoided. Although the latter fault may have very little influence on the cost, a more careful consideration of the design and the stresses imposed might result in much greater compactness and neatness.

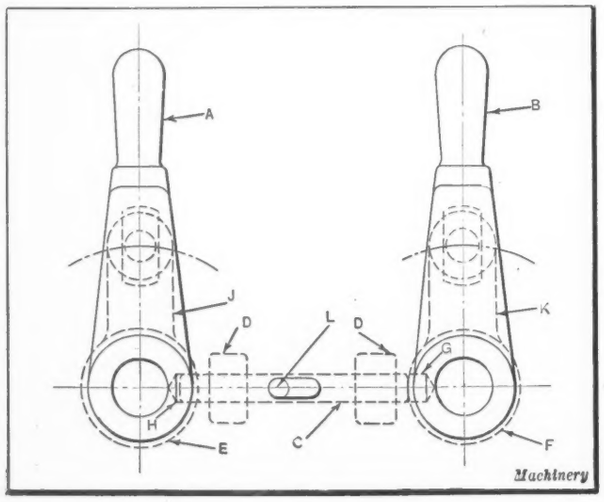


Fig. 1. Simple Arrangement of Interlocking Gear-change Levers

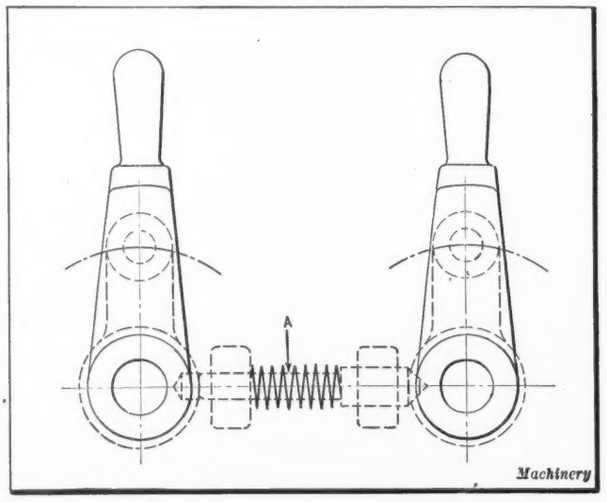


Fig. 2. Gear-change Levers with Automatic Interlocking Arrangement

Two-lever Type of Interlocking Mechanism

Fig. 1 shows a typical interlocking device, which, in various forms, is extensively used. The two levers *A* and *B* usually control two pairs of sliding gears by means of which one shaft is driven from another shaft at four different speeds. Since all the four pairs of gears are of different ratios, it is necessary to have some element introduced that will insure that one or the other of the two levers shall always be in the neutral position. Obviously, if some such provision were not made, there would always be a serious risk of one of the levers being accidentally engaged while the other was in engagement. This would, of course, be rather disastrous for the gears and other transmission elements concerned, and it is to avoid such a possibility that the levers are designed to interlock.

The locking element itself consists of a short piece of round steel *C* carried in bearings *D*, and engaging with holes *H* and *G*, in the bosses of the levers *J* and *K*. There is really no reason, except for the sake of appearance, why the sliding rod *C* should not be outside the gear-box housing and engage the bosses of the hand-levers *A* and *B*. A pin *L*, working in an elongated slot and fixed in the rod *C*, is the medium through which the rod is moved from left to right, or vice versa, as required. This arrangement is non-automatic and locking and unlocking are accomplished in a separate movement. As previously mentioned, this is not a desirable feature.

In the illustration, the lever *B* is shown unlocked ready for engagement. When it is swung either to the left or to the right, the hole *G* in the boss of lever *K*, is moved out of alignment with the rod *C*. It is therefore impossible for rod *C* to be moved, and since its left-hand end is engaged with the hole in lever *J*, it is also impossible to move the lever *A*, and the gears that it controls. If it were desired to use one of the gears controlled by lever *A*, it would first be necessary to move lever *B* to the vertical, or neutral, position, then slide the rod *C* to the right by means of the pin *L*, after which lever *A* could be moved either to the right or left as required, and *B* would be definitely locked out of engagement. It will be seen that the interlocking device involves another movement by the operator, and, since this can be eliminated without adding to the cost of the mechanism, it should be done, if possible, as it insures easier and more convenient operation.

Automatic Interlocking Device

Fig. 2 shows an interlocking mechanism in which the objectionable feature of the preceding design is overcome. Here a spring plunger *A* automatically performs the interlocking function. The plunger is supported in much the same way as in the previous example, but the spring tends to push it to the right. At the right-hand end it has a conical point which engages with a depression in the boss of the lever. Whenever the lever at the right is moved into the neutral position, the plunger is pushed into the hole

in the boss by the action of spring *A*. This unlocks the lever at the left, and allows it to be immediately shifted as required. When the left-hand lever has been moved, however slightly, from the neutral position, the end of the plunger comes up against the boss and prevents the plunger from moving to the left.

Since the right-hand lever can be shifted only if the plunger is allowed to move to the left, this lever is positively locked in the neutral position whenever the left-hand lever is in any position other than neutral. The arrangement shown in Fig. 2 is therefore to be preferred to that shown in Fig. 1. It not only works automatically, without requiring any attention or effort on the part of the operator, but it has also the additional advantage that it is rather cheaper to produce.

Fig. 3 shows another arrangement for use under conditions similar to the two previous ones. The two levers—either the inner ones or the outer ones (the former are preferable since they are generally enclosed)—are each fitted with a fan-shaped projection *A* and *B*. On the front side of the latter and the rear side of the former are two ribs *D* and *C*, respectively, which interfere with each other. Grooves *E* and *F* are cut across the center of the ribs to allow either of the levers to be moved as required. When the two levers are in the position shown in the illustration, the gears are in the neutral position, and either lever may be shifted. Whichever lever is moved, and no matter whether it is moved to the right or to the left, one or the other of the ribs is moved across the gap in the other rib, thus positively locking it in the out-of-gear position. The arrangement is quite an effective one and very cheap to produce, the only criticism that might be made against it being that it takes up more space than some of the other types. Good designers take a pride in concealing such devices, as a rule, but whether the practice is worthwhile when it involves greater expense is a matter for individual decision.

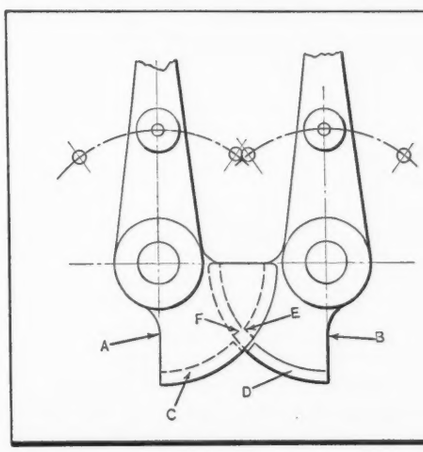


Fig. 3. Interlocking Levers that can be made economically

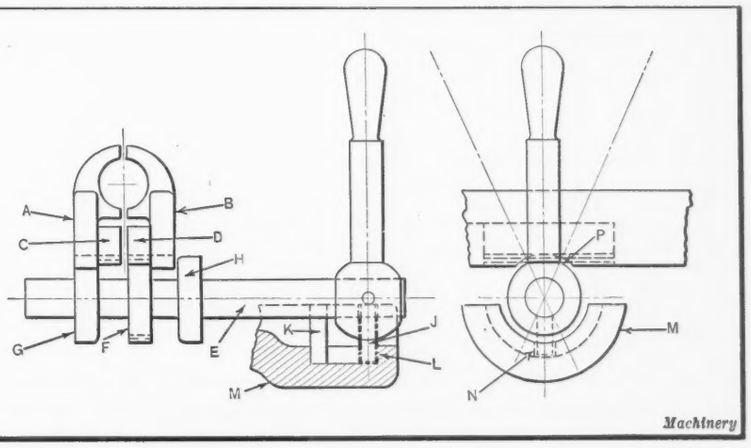


Fig. 4. Interlocking Single-lever Control for Two Sets of Gears

Single-lever Interlocking Device

While the three previous examples are much used in machine tool practice, none of them is ideal because there are two levers which must be manipulated in order to operate the sliding gears. The design shown in Fig. 4 is much superior in this respect, since only one hand-lever is required, and this lever is so arranged that it not only operates both sets of gears but also functions as an interlocking device. This combination permits quicker operation and, incidentally, gives greater compactness to the design.

The two sets of sliding gears are engaged by forks carried on bars *A* and *B* to which are secured racks *C* and *D*. The hand-lever shaft *E* has a pinion *F* and two plain disks *G* and *H* formed solid with it, and is so arranged that it can be shifted endwise as well as rotated on its own axis. The hand-lever is pinned or keyed to the shaft, and is fitted, in addition, with a pin *J* which projects into two segmental grooves *K* and *L* in a hollow semi-cylindrical casting *M*.

Connecting the two grooves and corresponding with the vertical position of the hand-lever, is a cross-groove *N*, approximately equal in width to the diameter of the pin *J*. With the hand-lever in the position shown, the pinion *F* is in mesh with rack *D*, and consequently the gears controlled by slide-bar *B* will be operated if there is any angular movement of the hand-lever. If the lever and its shaft are pushed bodily to the left, the rack *C* will be engaged by the pinion *F*, and the second set of gears will thus be brought under control. The function of the two disks *G* and *H* is to lock the slide-bar that controls one set of gears in a central position when the other set is in mesh. This is done by the disk being moved into suitably shaped hollows formed in each of the slide-bars, as shown at *P*.

In the illustration, the disk *G* is shown engaged with slide-bar *A*, so that the gears controlled by this bar are definitely locked out of engagement. If it is required to operate slide-bar *A*, the hand-lever must first be moved to the vertical position (all gears then being out of mesh), after which the lever is pushed to the left, thus engaging the pinion with rack *C*, and the disk *H* with slide-bar *B*. In this position, the gears controlled by slide-bar *B* are positively locked out of engagement.

The purpose of the grooves in casting *M* is to insure that the lever-shaft will not be moved axially, except when it is in the neutral position. This part of the device and the pin *J* could, if necessary, be carried inside the gear case, and the pin *J* could be fitted to either of the disks *G* or *H*. On these lines the design would be somewhat neater, though it is possible that it would not be quite so convenient in operation, as the grooves would then be out of sight and the exact vertical position of the hand-lever would have to be judged, more or less, by the "feel."

* * *

In a review of electrical developments during the past year, it is pointed out by the General Electric Co., Schenectady, N. Y., that there is a continued tendency toward increased unit capacity in electrical equipment. During 1923, one 62,500 Kv-A turbine-generator and one 65,000 Kv-A water-wheel generator were completed, and the largest synchronous converter on record was also built. In industrial motors, higher efficiency was obtained, as compared with previous practice, and advances were also made in the control apparatus used with such motors. In the turbine-generator field, the outstanding feature was the production of turbines for high steam pressures and in large sizes. One turbine of 35,000 kilowatts, designed for 550 pounds pressure and 750 degrees F. total steam temperature was built during the year. A 60,000-kilowatt unit to operate under similar conditions is under construction.

Two Quick-acting Jigs

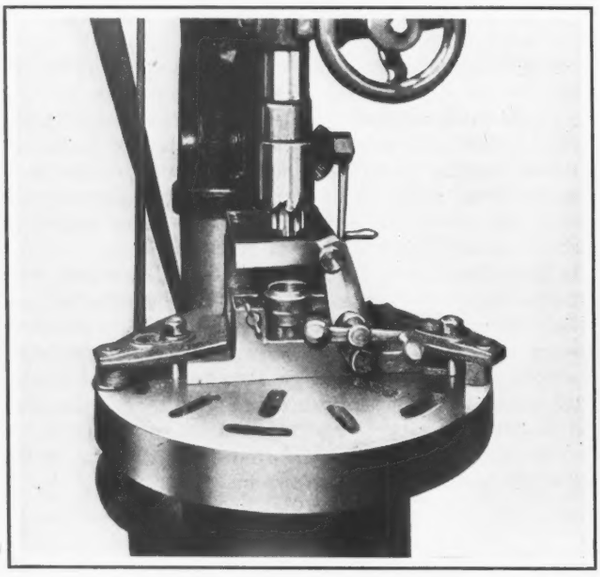


Fig. 1. Jig employed in machining Seven Surfaces of a Part on a Drilling Machine

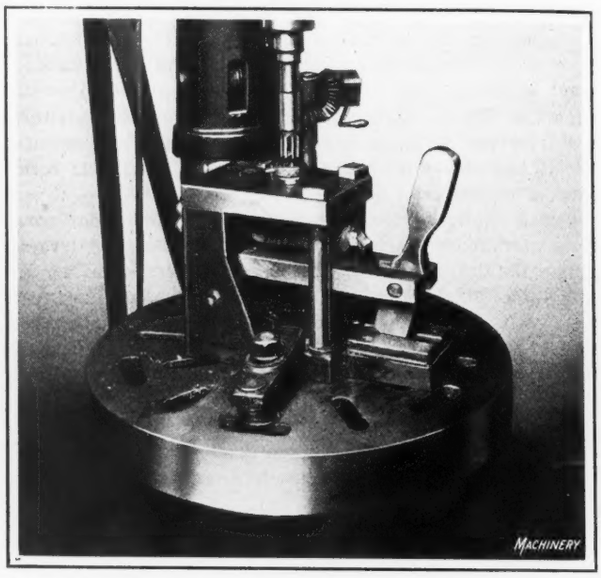


Fig. 2. Quick-acting Jig used in reaming Hole K of the Part shown in Fig. 3

THOSE surfaces of the part illustrated in the drawing Fig. 3 that are indicated by heavy lines are machined entirely on drilling machines. In one of the operations on this piece, counterboring, facing, and turning cuts are taken simultaneously on seven surfaces. The part is a steel forging that comprises the main housing of a lock for automobile steering wheels that is manufactured by the Eastern Tube & Tool Co., Inc., Brooklyn, N. Y. When received by the machine shop, the part is a solid forging having two generous depressions in each side of the boss. It is machined by the use of two quick-acting jigs as described in the following.

The first operations consist of milling the jaw and tongue at the ends, after which the forging is delivered to a drilling machine to have a hole 1 15/32 inches in diameter drilled through the boss. The drill is fed to such a depth that the point merely breaks through the bottom side of the boss and thus leaves sufficient metal for later producing the ledge near the bottom by counterboring from both sides. The next operation consists of counterboring surfaces *A*, *B*, *C*, *D*, and *E*, facing surfaces *F* and *G*, and turning surface *H*. For this work the combination tool and the jig shown in Fig. 1 are used. A long vertical bolt is used to hold the different sections of the counterbore together, and a transverse key keeps the different parts in the proper radial positions relative to each other.

From Fig. 4 it will be seen that in the jig used for this operation the part rests on the heads of three hardened plugs *P*, two of which are located beneath the boss and the other beneath the jaw end. The tongue end of the forging is clamped against block *A* by thumb-screw *B*, and one side of the jaw is similarly located against block *C* by revolving handle *D* to advance clamp *G* against the part. Blocks *E* and *F* come in contact with the boss and locate the part longitudinally in the jig. Loading is facilitated by the open-front design of the jig, link *H*, which carries handle *D* and the clamping member *G*, being lowered during the loading. After a part has been placed in the fixture, the link is swung upward over the stud and handle *D* is tightened. The production on this operation averages thirty pieces per hour.

In taking the counterboring, facing, and turning cuts on the bottom side of the boss, the part is held in a fixture provided with a plug that fits hole *A*, Fig. 3. Surface *F* seats on three finished pads spaced around the plug. The jaw is held between two vertical surfaces of a block to prevent the part from being rotated by the action of the tool. No clamping is necessary, and so the loading and unloading time is almost negligible. An average production of ninety pieces per hour is maintained on this operation.

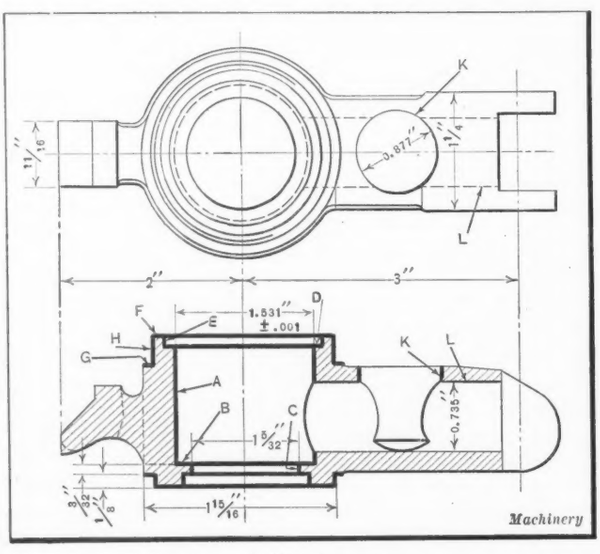


Fig. 3. Lock for Automobile Steering Wheels machined by the Use of Jigs shown in Figs. 1 and 2

Hole *K*, Fig. 3, is reamed with the part held in the fixture illustrated in Figs. 2 and 5. The bottom of the boss rests on a circular locating pad *A*, which is convex on the under side to fit link *E*. The pad is attached to the link by means of a fillister-head machine screw, the head of which is held in an elongated hole in the pad. This construction permits the pad to float slightly so that its upper surface will always be parallel with the bottom of the boss on the work. Accurate locating of hole *K* relative to the center lines of the boss is assured by plug *B* on which surfaces *A* and *F* of the work, Fig. 3, are seated, and also by rod *C*, Fig. 5,

which is inserted in the hole *L*, Fig. 3, previously reamed. Lug *D*, Fig. 5, takes the radial thrust of the part during the operation.

This jig can be quickly loaded and unloaded because of the provision for dropping link *E*. The link is lowered when handle *F* is swung outward at the top. The work can then be readily seated on plug *B*, and rod *C* pushed into the longitudinal hole, after which pad *A* is raised into contact with the part by simply pushing in handle *F*. The bottom end of the handle travels in a slot in a hardened steel plate. All downward thrust of the operation is taken by the link and the handle. An average production of 100 pieces per hour is obtained with this tooling equipment, hole *K* being reamed 25/32 inch deep.

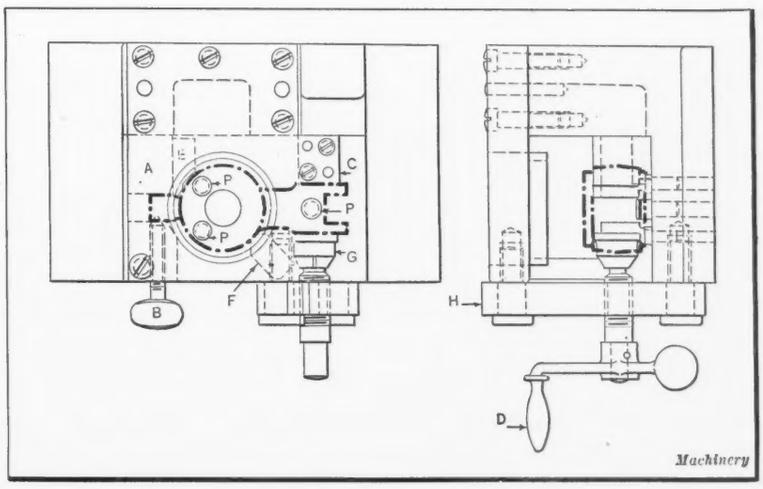


Fig. 4. Assembly Views of the Jig illustrated in Fig. 1

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REPORTS THAT REPORT

Some executives' desks are cluttered and their files choked with useless departmental reports. And yet, well-organized monthly departmental reports are constantly saving managers hours of labor and energy; but unless they are of real service and emphasize outstanding facts of value to the management they are a waste of time and energy. Investigation by the Business Research Bureau of the LaSalle Extension University indicates that little or no constructive business-building information can be gathered from many departmental reports, because department heads make the mistake of thinking that a mass of detailed facts and figures are necessary in a report made to an executive. As a matter of fact, the executive is interested more in a summary of detailed data or in the conclusions arrived at, than he is in the details themselves.

The executive is primarily interested in results and in the effect of certain factors upon his business. Definite methods will bring out clearly the factors desired. One essential of every report to an executive, therefore, is brevity. Let the sentences be short; let the figures be grouped clearly. Make every word count; be sure the important figures are not dwarfed by detail items. Short paragraphs are easier to read than long ones and much more effective. Where figures are an important part, line them up so that the eye follows them easily, and arrange them so that those in which the executive is most vitally interested will stand out the most prominently.

Graphic presentation of facts often affords the executive a quick and thorough understanding of the principles and facts covered by the report. For that reason, tabulation, charts, and graphs should be used to emphasize any information that can be graphically presented. This is especially the case when indicating the gradual development of a given operation or related results, such as cost figures, production reports, or sales records. Graphs and figures are helpful because the eye is brought into play and quickly "senses" danger signals or recognizes favorable indications.

The ideal report starts out with a brief statement of the subject under consideration, followed by a summary of findings and conclusions. By glancing over the first few paragraphs the executive forms an immediate impression of the operations of that particular department for the period in question. If the conclusions arrived at in the report show up all the vital factors involved, there is no need to wade through the mass of detailed facts, figures, and statements from which these conclusions were drawn. In comparing one departmental report with another, the executive may find it necessary to refer to the detail data upon which the reports were drawn. For that reason summaries or conclusions should always be supported by the facts on which they are based. These facts should be supported by the specific evidence and actual figures as drawn from the records of the departments.

Every report to an executive should be so arranged that quick reference can be made to any part of it. If the report is lengthy, a separate index page may be useful. For instance, in the summary, references should be made to the page, table, or paragraphs that are used as a basis for the statements made.

In the preparation of a report, the purpose for which the report is intended should always be kept in mind. Particular emphasis should be placed upon the extraordinary and the exceptional, rather than upon the normal conditions. No two reports will be drawn up exactly alike, or according to the same general outline. It is practically impossible to give any outline or fixed form in which a report should be drawn up. For this reason, only the general fundamental principles can be pointed out.

Carefully made reports form the best basis upon which a manager can make an intelligent estimate of the controllable and uncontrollable factors of his business, and direct the installation of newer and better methods.

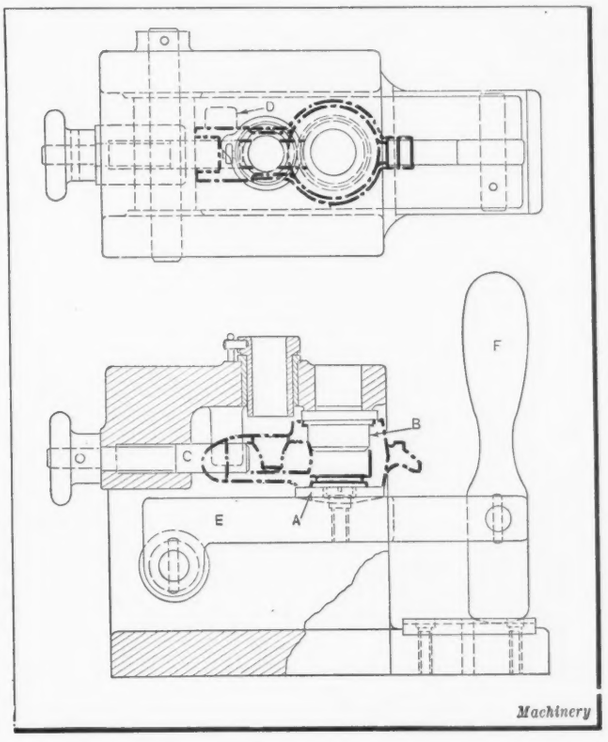

Fig. 5. Views of the Jig used in the Operation shown in Fig. 2

Design of Machine Tool Feet and Bases

Typical Designs for Different Classes of Machines—Second of Three Articles

By FRED HORNER

THE first installment of this article, which was published in December MACHINERY, described various forms of feet used to support the frames or bodies of boring machines, drilling machines, and grinders. The advantages and the limitations of the three-point method of supporting machine tools and the means provided to facilitate leveling up machine tools on their foundations were among the features dealt with in the December installment. The present article deals with feet for lathes, planers, automatic screw machines, and shapers.

Lathe Feet

For lathes there is a great variety of forms and styles of feet to choose from in cases where two feet are required. The form to be used depends on the weight at the head end of the lathe and the class of work to be done. An elementary form of foot for bench lathes consists of elliptical pillars cast integral with the bed, and located a little way from the ends, as shown in Fig. 6. The use of an elliptic instead of a circular cross-section gives the advantage of greater resistance against the cross stresses resulting from the drive of the belt and the movements of the work. On such a small scale it is not worth while to cast the feet separate from the bed, as this would only result in additional complications due to the necessary screw fastenings.

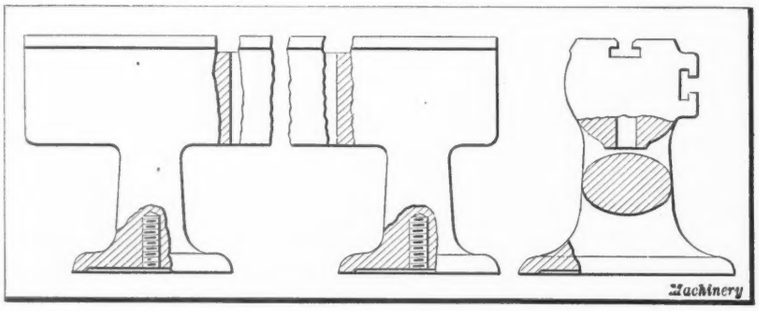

Fig. 6. Type of Feet used on Bench Lathes

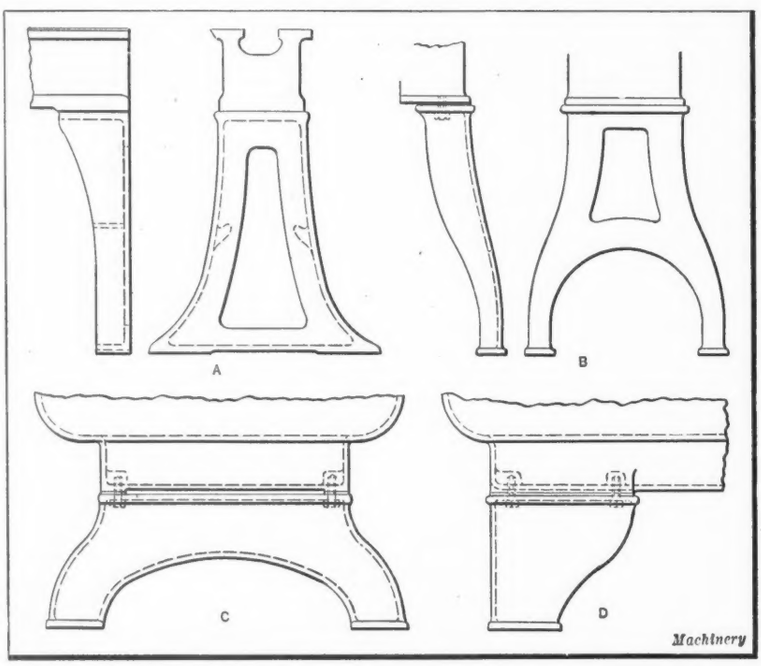

Fig. 7. (A) and (B) Standard Types of Feet for Light Lathes; (C) and (D) Side and End Views of Headstock Foot of Rigid Design

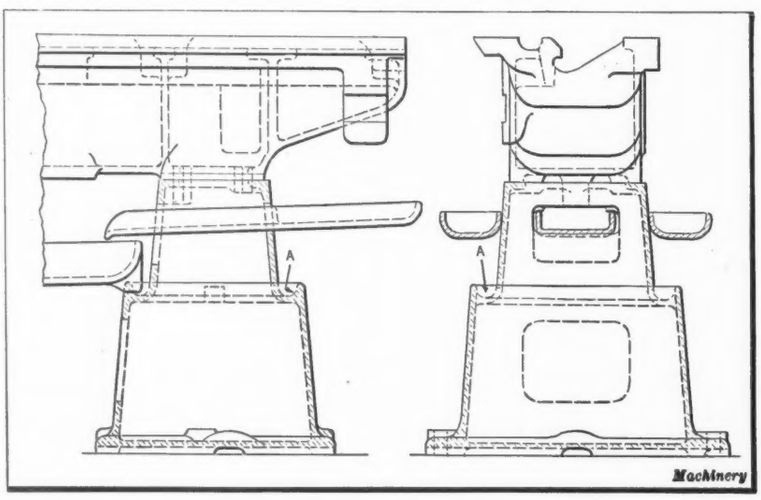

Fig. 8. Lathe Foot provided with Prong Tray

For the lighter kinds of lathes, where there is no heavy headstock nor system of feed gears to be carried, it is satisfactory to employ feet like those shown at *A* and *B*, Fig. 7. The contact obtained between the foot and the bed by the fastening bolts is enough to prevent the parts from working loose, while the contact on the floor is spread out to prevent the machine rocking.

When, as in so many modern designs, the headstock exceeds the bulk of a simple belt-driven pattern, greatly increased bearing areas become essential. The Hartness double-spindle flat turret lathe, the foot of which is shown in views *C* and *D*, is an excellent example of this type of machine. Under the massive and wide head of this lathe there is a well-designed foot having a wide spread. A favorite practice, when the bed happens to stand sufficiently far from the floor and the pan arrangements do not complicate matters, is to employ a cabinet leg under the headstock. The box structure of this leg affords greater stiffness and stability,

and also provides storage space. The leg at the other end may still be a simple open one, like that shown at *A* or *B*. It is occasionally fitted in a pivotal fashion to the bed, to eliminate any danger of twisting the latter member.

The shape of a lathe foot is often worked out so that it will serve as a means of supporting the chip pan (when a cabinet leg is not fitted), and it may be arranged to provide for draining the coolant. A distinct departure from conventional methods appears in the patented lathe foot shown in Fig. 8, which was developed by an English concern. The coolant tray does not merely surround the leg under the back end of the bed, but a prong of it passes through the foot, and consequently there is a gain in capacity as compared with the usual tray which encircles the exterior portion of the pillar and catches the chips and coolant that fall between the shears. This forked tray leads into the main tray, at the end of which lies the sump and pump equipment which is contained in the headstock foot. What little oil or compound gets below the forked tray is intercepted by the recess *A* (which forms a support for the main tray), and is conducted into the interior of the foot, where it is baled out periodically. Thus the floor does not become wet or stained.

It is obvious that lathe beds and feet should be so designed that all spans of unsupported metal will be as short as possible. For this reason the feet on the more recently designed lathes (say those designed during the last fifteen years) have been located away from the ends, rather than directly under them. The bed is better sustained in this way, and the heavy pressure and twisting strains set up just in front of the headstock when doing heavy faceplate and chuck work are better taken care of. This point is even more important in gap-bed lathes, the foot being brought along nearer the gap or partly underneath it. For the larger lathes the feet are either a continuation of the bed on all sides, that is, a casting reaching to the ground at all points; or, perhaps, a foot extends from the end of the bed to the end of the gap, as shown in the view at *A*, Fig. 9. With regard to multiple feet—that is, more than two and up to as many as a dozen—it is not possible to lay down any rule for the proportion of the number to the length of the bed. This depends on many variable factors, such as the bed cross-section and the kind of work done.

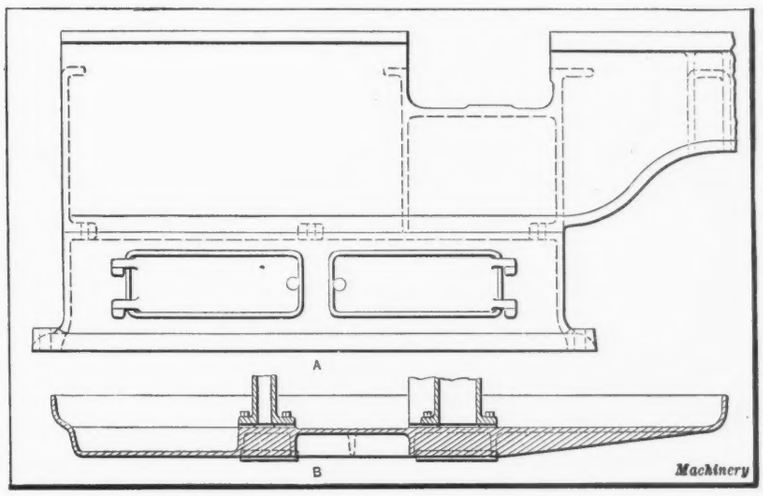

Fig. 9. (A) Long Type of Foot designed to support Gap; (B) Foot Design of an Automatic Screw Machine

Types of Feet for Automatic Screw Machines

Capacious chip and coolant pans were first used on automatic screw machines. A new style in machine feet was also set by the automatic screw machines. Now, in addition to these long-established machines, there are the automatic turning machines and the large turret lathes, which either stand in a big tray or have a cast base of good depth that has sufficient space to hold a plentiful supply of oil or compound and a large quantity of chips.

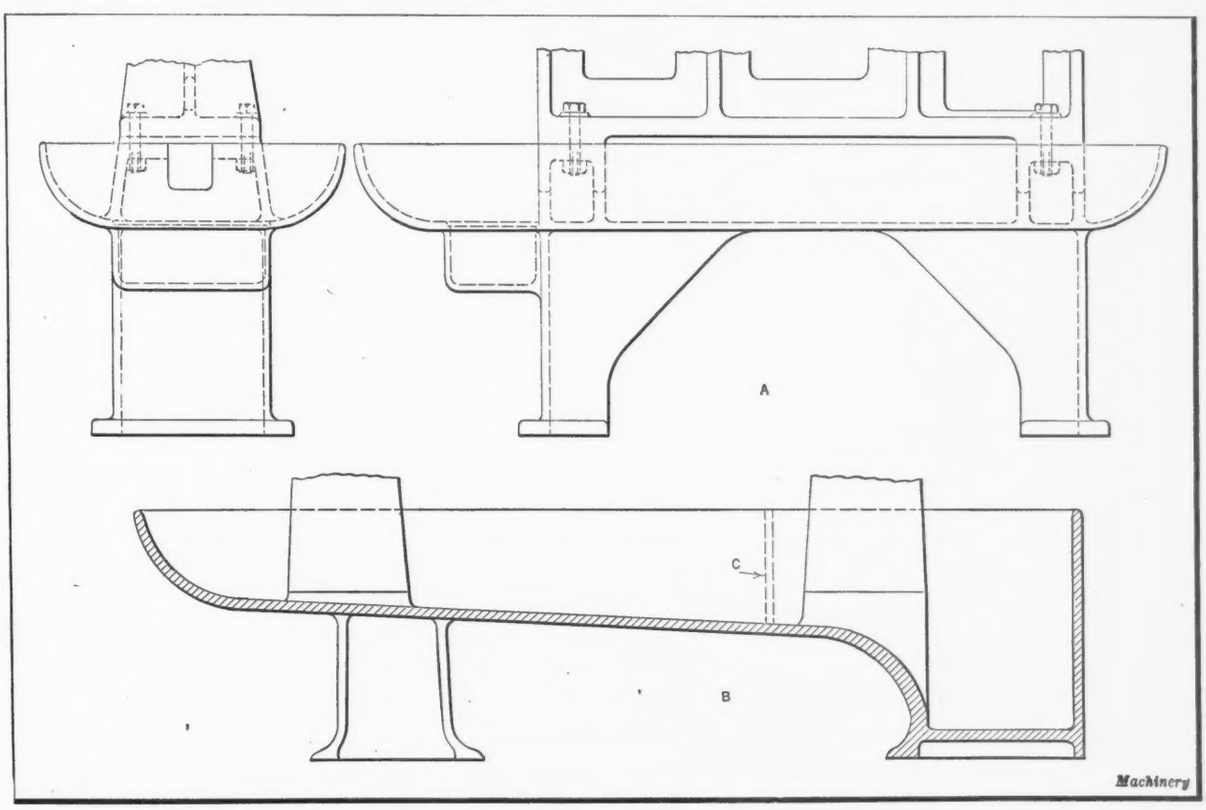

Fig. 10. (A) Type of Foot with Bed cast Integral; (B) Foot Design in which Tray and Sump are combined

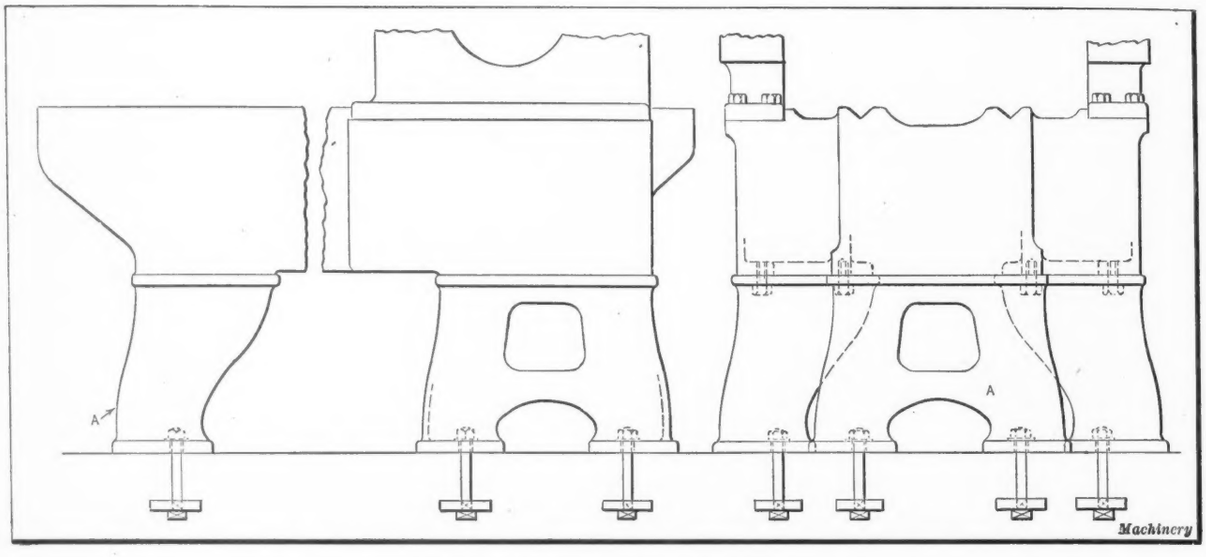

Fig. 11. Splayed Foot Design used on Planer

A good example of tray design (shown in the diagram at *B*, Fig. 9) is to be found on the Gridley single-spindle automatic turret lathe. This tray is strongly ribbed beneath, and has feet that contact with the floor immediately below the frame standards. For a smaller automatic screw machine, the design shown at *A*, Fig. 10, finds considerable favor. Although the pan of this machine is of ample size, legs are required beneath it to raise the machine to a suitable height. Quicker and more effective separation of the oil from the chips occurs if a slope is given to the pan floor, so that it will drain into a reservoir at a lower level. The pan shown in the view at *B*, for instance, has a slope of ¾ inch to the foot; it has a capacity for holding 318 pounds of steel chips, and will hold 25 gallons of coolant in the reservoir. A strainer occupies the position just in front of the rear standard of the frame, as indicated by the dotted lines at *C* in the illustration.

Forms of Feet for Cylindrical Grinders

The working conditions on a cylindrical grinder are essentially different from those on a lathe, because of the high-speed grinding wheel, and the necessity for obtaining such close accuracy and freedom from chatter. Hence, two supporting feet are never used on this type of machine, but a bed of heavy construction is employed, which is strongly ribbed inside and extends to the floor or stands on a foot of large area. Vibration is absorbed by this firm construction. Three-point contact can be adopted for machines up to about 10 feet capacity between centers, but beyond this, a foundation is necessary to prevent deflection. Wedges with screw adjustments can be used for truing up these machines.

Foot or Base Designs for Planers

As previously mentioned, the work performed on a planer causes severe strains to be imposed on the feet. The feet

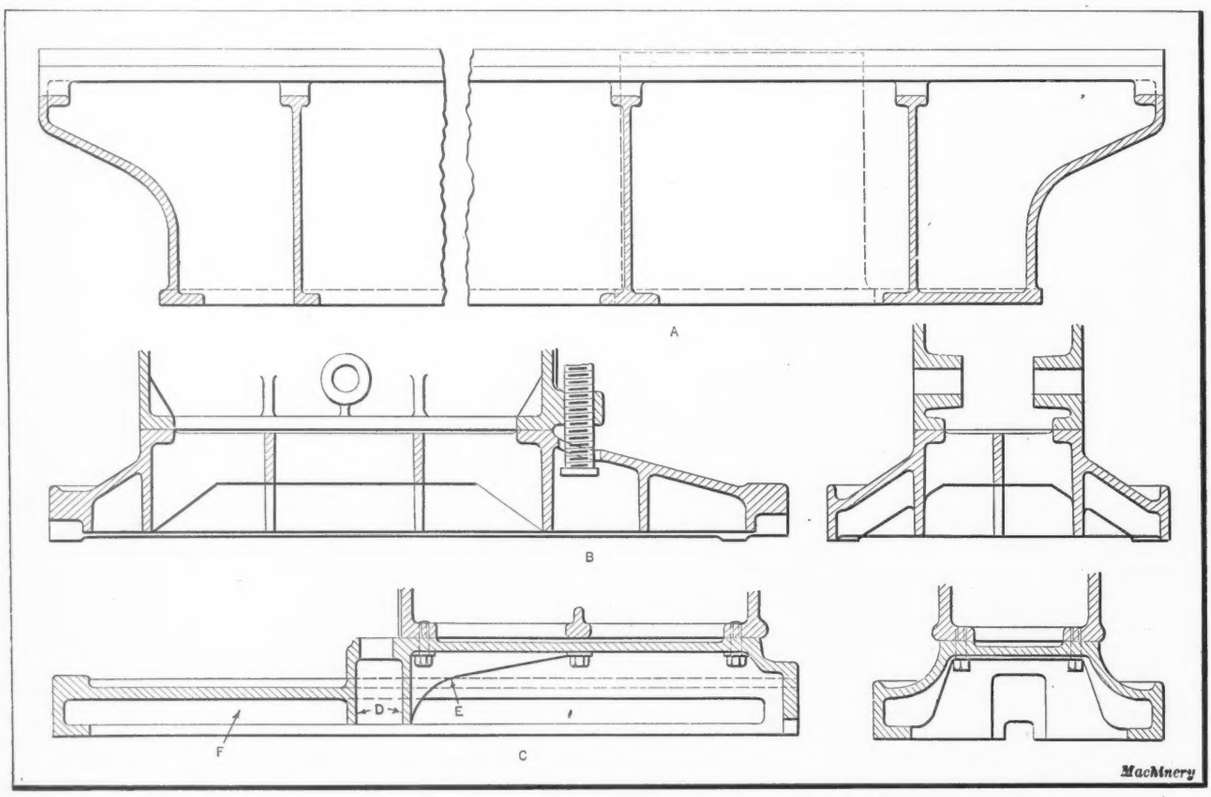

Fig. 12. (A) Type of Bed used on Plano-Miller; (B) Shaper Foot provided with Longitudinal and Transverse Ribs; (C) Another Type of Shaper Foot

must have ample contact with the foundation and the bed, to avoid the risk of springing and prevent the fastenings from working loose. They should be designed to resist the longitudinal alternating shocks; that is, they should be splayed outward like the foot shown at *A* in Fig. 11. This illustration shows a planer bed of moderate length which does not require a similar foot at the opposite end; in this case the other end rests on a pair of splayed feet that support the wings of the housings.

As planer beds are made deeper and necessarily extend nearer the ground, the feet become stumpier and more frequent in number with an increase in the length of the bed, until total elimination of the feet occurs and the bed rests directly on the foundation piers. The leveling of a planer is not done, of course, with the table in place, but with reference to the vees on which it slides. To use the level, rollers of exactly uniform diameter are laid in the vees, and a straightedge placed across these rollers, so that a true bearing for the level is obtained. Special V-blocks can be employed in place of the rollers. Some makers plane the top ledges of the beds, adjacent to the vees, thus simplifying the leveling operation.

Plano-miller Supporting Base

Plano-millers differ from planing machines in that they are never provided with feet, the beds always being extended to the foundation as an essential precaution against vibration. Cross-girts are cast between the sides of the bed, which serve as feet in conjunction with the end webs, such as shown by the view at *A*, Fig. 12. This view also shows alternate methods of making the ends. The end at the right is made with a foot that has a bottom web that extends from the first girt to the end wall or foot. The dotted outline behind the bed is that of the flank for receiving one housing.

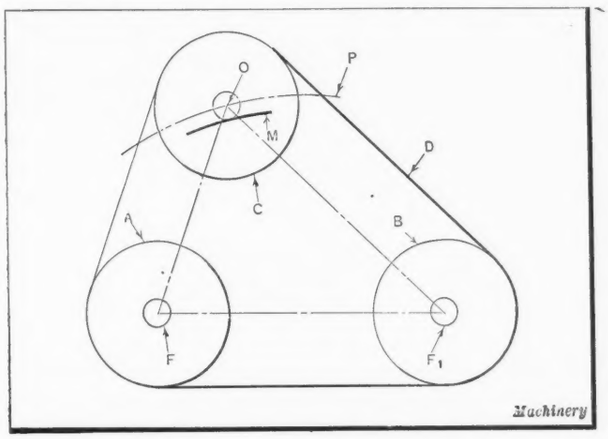

Fig. 1. Diagram showing Fixed Center Pulleys F and F_1 belted to Oscillating Pulley C

Foot Arrangement of Shapers

The foot arrangements of shaping machines of some sizes and types have changed in form to some extent since the introduction of the well-known table support and coolants for cutting have come into common use. The base has consequently been projected forward to provide for the first-named modification, and provided with a raised rim for the second. On those sizes of machines where it is not convenient to cast the column and base in one piece, a strongly ribbed foot is made, which is rigid enough to withstand slight defects in the foundation. The forward projection serves to increase the steadiness of the whole machine. As examples of this practice, the base for the Cincinnati shaper shown in the view at *B*, Fig. 12, and that of the Columbia shaper shown at *C* may be studied. The first has a series of longitudinal and cross ribbing; the second has two cross-ribs, and from the boss *D* two longitudinal parallel ribs *E*, while on the other side there is one straight rib *F* and two ribs that radiate into the corners.

DEVELOPING ELLIPSE FOR A PULLEY-SHAFT GUIDING CAM

By HARRY BROOK

The method of developing the segment of an ellipse here described was employed in designing a cam used on a special machine. In this machine there are two driven pulleys *A* and *B* shown diagrammatically in Fig. 1, which run on fixed centers *F* and F_1. The pulleys *A* and *B* are driven from pulley *C* by means of a belt *D*, while the pulley *C* oscillates through the path indicated by line *P*. As the belt tension must be uniform, the distance $FO + F_1O$ must be constant. Therefore the path *P* must be a segment of an ellipse with the foci at *F* and F_1.

In order to keep a uniform tension on the belt *D*, it was necessary to provide a cam *M* that would guide the shaft *O* of pulley *C* along the path indicated by line *P*. It is obvious that the guiding surface of cam *M* must be a segment of an ellipse and parallel to line *P*. The point *O*, with the pulley *C* in the position shown, is a known distance from shaft *F* and from shaft F_1. The line *ab*, Fig. 2, is laid off equal to $FO + F_1O$. This line represents the major axis of the ellipse. The distance FF_1 is laid off so that aF equals bF_1. A number of points *c*, *d*, *e*, *g*, etc., are laid off arbitrarily on line *ba*.

A pair of dividers is next set to the desired distance *bc*,

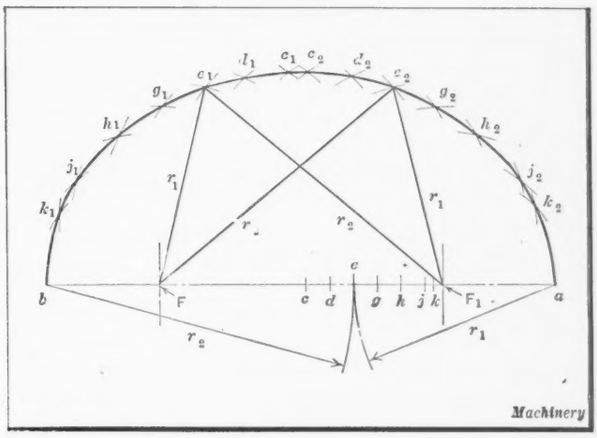

Fig. 2. Diagram showing Method of developing an Ellipse for a Cam Surface

and arcs are drawn at c_1 and c_2, using F_1 and *F* as centers. The dividers are then set to the dimensions *ac*, and with F_1 and *F* as centers, arcs are drawn which intersect the arcs previously drawn at c_2 and c_1.

These points lie on a line forming a true ellipse. The same procedure is followed in drawing the intersecting arcs at d_1, d_2, e_1, e_2, etc. The method of thus locating the points e_1 and e_2 is clearly indicated by lines r_1 and r_2. A curve drawn through the points located by the intersecting arcs will give the outline of the ellipse desired. One advantage of this method of laying out the ellipse is that any part of its outline may be drawn if one point and the foci are known without knowing the minor axis.

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EFFECT OF GRAIN SIZE IN BRASS ON CORROSION

In a paper read before the American Institute of Mining and Metallurgical Engineers, an investigation relating to the effect of the grain size in brass upon its corrosion is described. Contradictory opinions have been expressed in the past on the effect of the grain size. The experiments made show that for the brass tested and the corrosive solutions used, the effect of the grain size on corrosion is very small, and can probably be ignored for practical purposes. In general, however, brass with smaller grain size corrodes less than that with larger grain size. The method for testing corrosion that has been developed at the Bureau of Mines was employed.

Constructing Automobile Radiators

Building up Tubular Radiator Cores of the Flat Fin Type from Brass Stampings and Tubes

By CHARLES O. HERB

A RADIATOR core constructed of flat brass fins and vertical tubes of elongated cross-section is supplied on the automobiles and "speed wagon" motor truck built by the Reo Motor Car Co., Lansing, Mich. After the fins and tubes have been assembled, the core is dipped into a bath of molten metal to solder them at all joints, covering their entire surfaces with a thin coating of the solder and thus obtaining a sturdy construction. The upper and lower tanks are then soldered to the core, and the radiator tested to make sure that it is water-tight. The tubes are purchased, but the fins are stamped out on a power press. The operations outlined form an interesting process, and will be described in detail in the following.

Preparing the Stock for the Stamping Operation

Brass coiled stock, 0.005 inch thick and 3½ inches wide, is the material from which the fins are stamped. Prior to this press operation, both edges of the stock are bent back so as to strengthen the fin, the final width being 3 3/16 inches. The bending operation is accomplished by means of the equipment illustrated in Fig. 1, which comprises three sets of gear-driven rolls through which the stock is drawn. Each set of rolls is driven through spiral gearing from a shaft running the length of the machine at the rear. On the upper roll of the first set at *A*, the part that contacts with the stock is of a length somewhat less than the distance between the two housings that support the rolls, and it seats between two shoulders of its mating roll. The result of this construction is that as the stock is drawn between the rolls, the edges are bent upward at right angles an amount equal to the height of the shoulder on the lower roll.

The rolling part of the upper roll of the second set at *B* is also slightly less in length than the width between the housings, but it does not seat in the lower roll, the purpose of this set being simply to feed the stock steadily under a guide *C* on each side of the machine. These guides bend the upright edges of the stock toward each other at an angle of approximately 45 degrees. The edges are finally bent down flat against the stock by the action of the rolls at *D*. The lower roll of this set is of true cylindrical shape, while the upper is beveled slightly near the housings. From these rolls the stock is coiled on a large spool, which holds about 1800 feet of stock, this being a sufficient amount for the production of about 500 fins.

Fig. 1. Equipment for bending back the Edges of the Fin Stock before stamping the Fins

Piercing and Cutting off the Fins

Each fin is made 21 inches in length, and has three rows of 28 holes each in it, which are about 5/8 by 3/16 inch, to suit the tubes which are later assembled in them. Two fins are produced simultaneously by employing a double piercing die on the Toledo No. 3 inclinable press illustrated in Fig. 2. Four holes are punched in each row of the two fins at each stroke of the ram, seven strokes being necessary to complete two fins. The stock is fed to the dies by means of two sets of rolls which receive an intermittent drive from a standard ratchet equipment connected to the crankshaft of the machine. A braking arrangement eliminates all play of the driving gears and insures that the rolls will function properly.

As the stock leaves the rolls, it passes between guides which prevent it from buckling when the holes are pierced. The punches have blunt bullet shaped noses which break gradually through the metal and bend it back all around the hole at right angles to the strip, the upright edge later assisting in holding the fins to the tubes. As the punch descends, guides on a stripper plate attached to the punch under spring pressure enter three previously punched holes in each strip of stock, and shift the stock slightly forward or backward, to locate it properly for the operation. This shifting is accomplished through an arrangement which serves to lift the upper feeding rolls a slight amount at this time.

The two fins are cut from the stock by knife blades held in a bracket mounted at the right-hand side of the press, as shown in Fig. 2. As previously mentioned, seven strokes of the ram are required for piercing all the holes in a fin and so these knives function but once at every seven strokes. This intermittent operation is produced by the mechanism illustrated diagrammatically in Fig. 4. On the right-hand side of the ram is mounted a 14-tooth ratchet *A*, which is brought into contact with a spring-actuated finger *B* on the housing of the machine at each upward stroke of the ram, so that the ratchet is indexed one-fourteenth revolution at each stroke.

Diametrically opposite each other on ratchet *A* are two screws *C*, and at

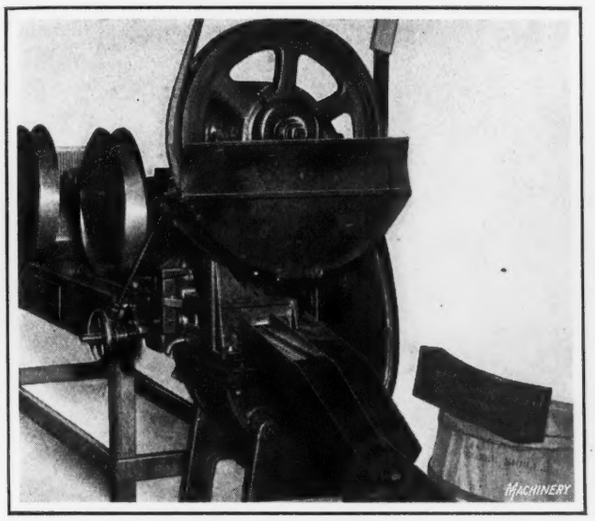


Fig. 2. Power Press equipped with Shearing Attachment that cuts off Two Fins at Every Seventh Stroke

Fig. 3. Loading Fins into the Fixture of the Machine used to push the Tubes through the Top Plate of the Lower Tank and the Fins

each seventh stroke of the ram, one of these contacts with the upper end of lever *D*, swiveling the lower end of the lever to the right so that it engages with the frame containing shear blades *E*. Then, at the next stroke of the ram, lever *D* forces the knife frame down to shear off the fins. The spring-actuated pawl *F* prevents the ratchet *A* from turning backward when contact is made with lever *D*, and spring *G* insures that the latter will disengage from the knife frame when either of screws *C* has passed the upper end of the lever. The average production on this machine is 1900 fins per hour, which is sufficient for about 13½ radiators.

Assembling the Fins and Tubes

Each radiator core is made up of about 140 fins and 84 tubes. The tubes are 21⅜ inches long, and the fins are spaced equidistantly for their entire length, except for about ½ inch at each end, where they project to enable them to be inserted in the upper and bottom tanks. The assembly of the fins, tubes, and the plate that forms the top of the lower tank is accomplished by means of the equipment seen in the heading illustration and in Fig. 3. The tank plate is also a brass stamping, but it is made of considerably heavier material than the fins, being about 0.049 inch thick. For this operation, the fins are placed in the fixture at the left-hand end of the table, as illustrated in Fig. 3, which is provided with a large number of narrow slots *A*, Fig. 6, to receive them. These slots are formed by rows of upright fingers, of rectangular cross-section, which are equally spaced each way. Paths *C*, of which there are 28, run transversely across the fixture to receive the tubes as they are assembled in the fins.

In loading this fixture, the operator holds a handful of fins on it, as shown in Fig. 3, grasping them tightly with his left hand and allowing them to spread slightly at the other end so that they may be gradually pushed into the fixture slots by pressing down on them with his right hand. The lower tank plate is supported on lugs in the fixture on the side nearest the head end of the machine. When the fins have been placed in all the slots, the tubes are inserted in approximately one-half the holes in the end plate and through the first few fins, after which the head of the machine is utilized, as shown in the heading illustration, to push the tubes through the slots in the end plate and all the fins. The latter are adequately supported during this operation by means of fingers *B*, Fig. 6. When the tubes have been completely assembled, the head is returned to its original position by a counterweight, after which the remaining tubes are assembled in the same manner. Each tube is held in an approximately vertical position on the ram during this step by two small pins.

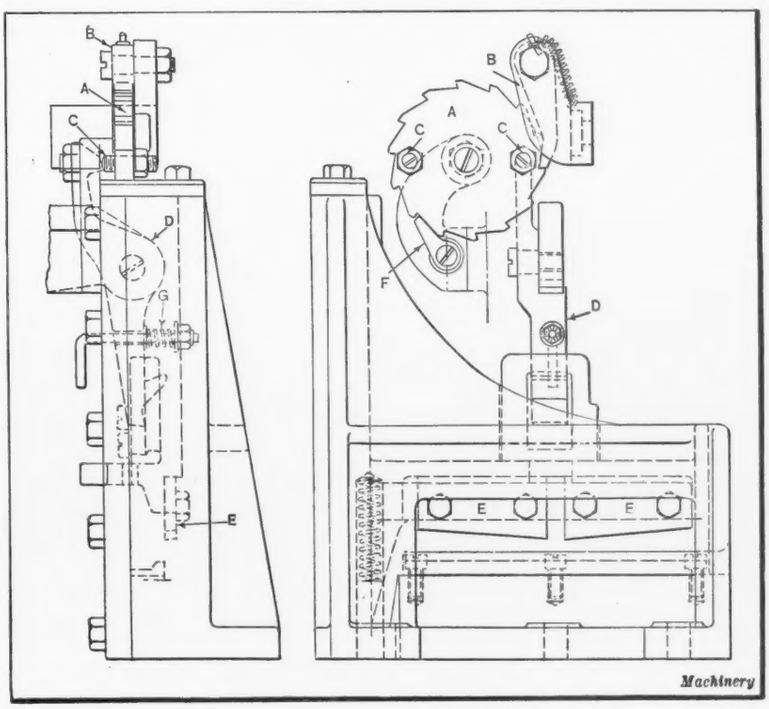


Fig. 4. Mechanism that operates the Cutting-off Knife Blades in the Power Press at Every Seventh Stroke of the Ram

The assembling ram is fed forward by a power-driven pinion, which engages a rack attached to the rear of the ram. It is important that the tubes be slid into position easily, in order that neither they nor the fins become strained; therefore a quick-acting control is provided so that the operator may instantly end the movement of the ram, whenever he so desires. From Fig. 9 it will be seen that the horizontal shaft running along the left-hand side of the head carries a worm *A* which drives a bronze worm-wheel *B* running idly on vertical shaft *C*. At

the lower end of this shaft is mounted a pinion which drives the large spur gear seen at the head end of the machine in Fig. 3. The pinion for driving the feed rack is mounted on the upper end of the same shaft as this large gear. Keyed to shaft *C*, directly above the worm-wheel and with a flange extending into it, is a clutch *D*, Fig. 9, of unique design. As will be seen in the plan view, the flange of this clutch is split at *E*.

Normally, the flange of the clutch does not come in contact with the inside of the worm-wheel, and the worm-wheel rotates without driving anything, but when it is desired to drive shaft *C*, the clutch flange is expanded to a tight fit in the worm-wheel, and thus transmits power to shaft *C*. The operator expands the clutch by revolving the handwheel *F*, producing a tension in spring *G* which is connected both to the handwheel and the clutch. This causes the clutch to turn on its axis so that the locked screw of arm *H* will ride up on the lobe of cam *K*, thus swiveling pin *L* on which the arm is mounted. The cross-section of the lower end of pin *L* is elongated, and as the smaller width is normally a close fit between the split ends of the clutch flange, when the pin is swiveled the longer width is forced between the split ends and expands the flange. The drive can be instantly ended by the operator's releasing his hold on handwheel *F*, to free spring *G* from tension.

When this operation has been completed, the assembled core is lifted from the fixture by an overhead hand hoist. Attached to this hoist by means of links are two long bars having three ledges, each of which fits under the projecting tubes at the ends of the radiator.

Fig. 5. Dipping the Radiator Core into a Bath of Molten Solder

Dipping the Radiator Cores into Solder

The assembled cores are next taken to a department where they are immersed in a solution of muriatic acid to cleanse them thoroughly from dirt and grease, and then dipped into a bath of molten solder consisting of 50 per cent lead and 50 per cent tin. The temperature of this bath is kept at about 700 degrees. For dipping, the core is supported on a frame by the tube ends, as shown in Fig. 5, the frame being mounted on a swiveling post which is lifted hydraulically to raise the radiator from the pot after the operation. The radiator is left in the pot from one to two minutes. Means are provided for vibrating it above the pot after dipping, so as to throw off as much excess solder as possible. In this operation, all surfaces of the fins and tubes are given a thin coating, which strengthens the construction of the core and solders all joints, as mentioned at the beginning of the article. The furnace uses gas for fuel, and is provided with six burners. Dross is cleaned from the pot six or seven times a day.

When they are removed from the dipping frame, the cores are placed on a grate composed of flat bars and round rods, and again shaken by the furnace attendants to throw off all excess solder. The core is then put in a frame and clamped, while still hot, to straighten out any twists which may have been produced in soldering. While in this frame, air is drawn through the fins to cool the radiator more rapidly.

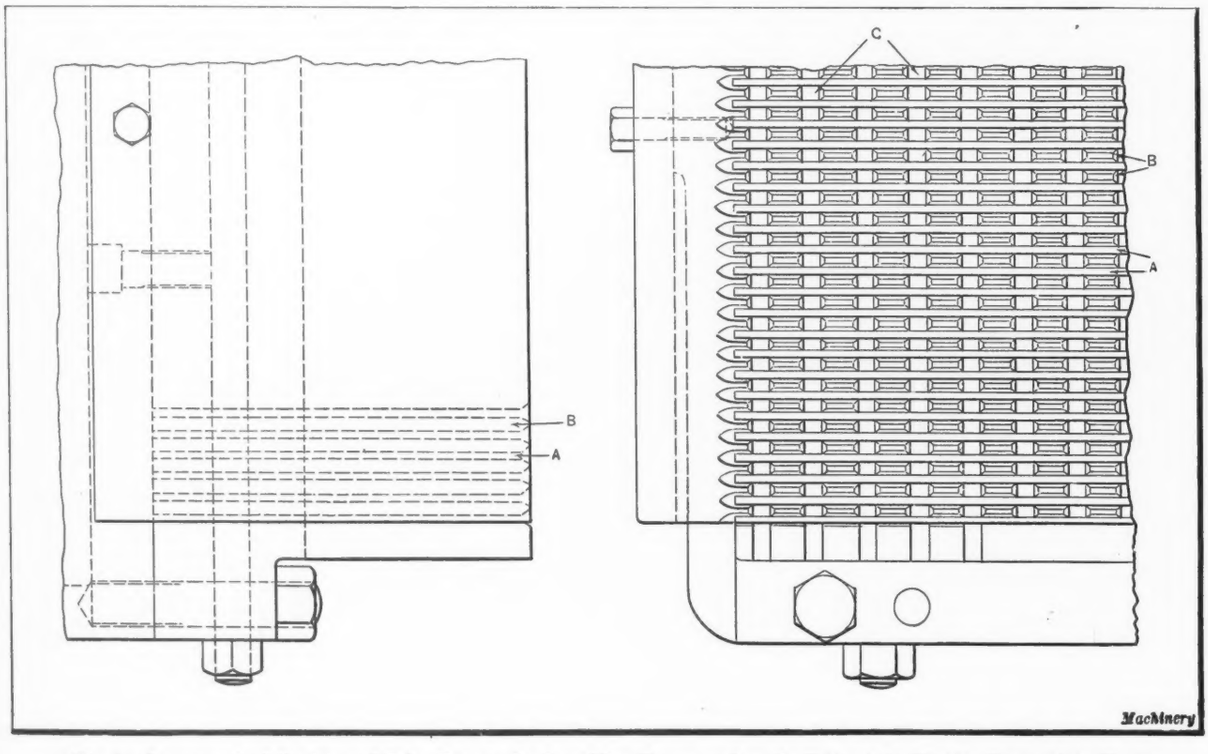


Fig. 6. Arrangement of the Fin and Tube Slots in the Assembling Fixture used on the Table of the Machine illustrated in Fig. 3

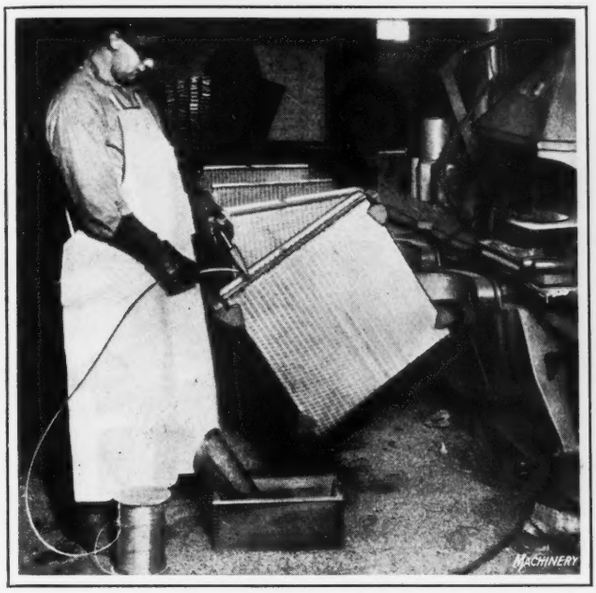


Fig. 7. First Operation on the Radiator Core after being assembled on the Traveling Jig

Fig. 8. Pulling Main Part of Upper Tank on Radiator Tubes with Compressed Air Equipment

On an average 162 radiators are handled per ten-hour day in this department.

Assembling the Top and Bottom Tanks

For assembling the top and bottom tanks, the radiator cores are held in a traveling jig, which is pushed from one workman to another around a large oval track, the top rails of the track supporting table boards, on which are placed furnaces for heating the soldering tools and other equipment used in this work. An idea of the construction of the jig may be obtained from Fig. 7. It is supported by two rollers at the bottom which run on the horizontal leg of an angle-iron, and is prevented from tilting outward at the top by a roller which runs on the vertical leg of an angle-iron located on the inside of the wooden plank that may be seen in the illustration. Two additional rollers running on the vertical leg of the lower angle-iron are provided to take the side thrust of the load at that point.

Extending outward from the carriage portion of the jig is a bracket which may be swiveled around a complete circle and which supports the part of the jig in which the radiator core is clamped. This jig part may also be turned through an entire circle, and so it is possible to hold the radiator in any position while performing the various steps around the track. A coil spring at each of the swiveling points sets up sufficient pressure to hold the jig parts in any position in which they may be placed.

The first operation on the assembling track, as illustrated in Fig. 7, consists of more firmly soldering the 84 projecting tube ends to the end plate of the lower tank, so as to make these joints absolutely water-tight. Before beginning to solder, a flux is blown across the end-plate from a container which has a compressed air connection. The amount of air escaping may be adjusted to regulate the richness of the mixture. Then the entire inside surface of the end plate is coated again. The workman holds a right-angle soldering

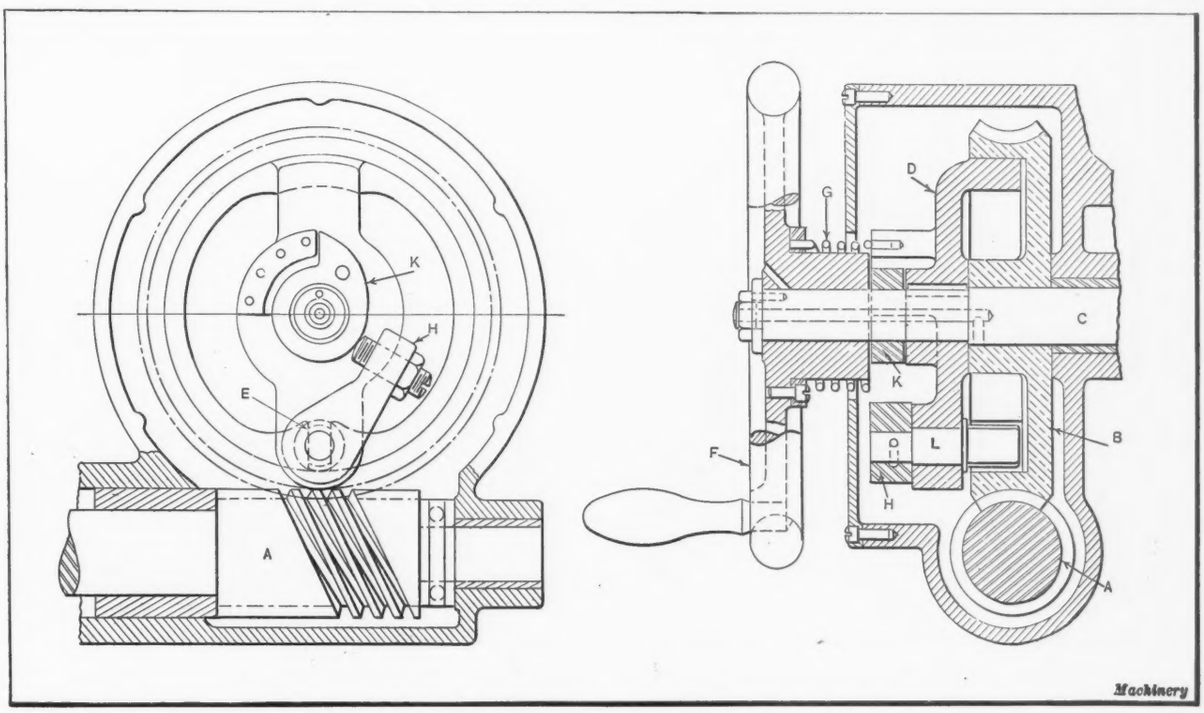


Fig. 9. Sectional Views of the Mechanism for controlling the Ram Movements in the Assembling Machine shown in Fig. 3

Fig. 10. Soldering the Upper Tank to Each of the Projecting Tubes

Fig. 11. Assembling Cover of Upper Tank and making it Water-tight

iron in his left hand and feeds "shoe-string" solder from a spool with his left hand. The soldering irons are kept hot by laying them on a plate in front of the gas furnace at the right of the illustration.

The second man on the assembling track puts more solder around four tubes in each row on both sides of the radiator at the top end, this practice having been found essential. The jig is then pushed to the third man, who assembles the main part of the top tank by means of the pneumatic equipment illustrated in Fig. 8. The radiator is swung into a vertical position, and the bottom tank plate placed over the end of a ram shaped to fit it. Then the upper tank part is placed on the radiator with its perforations over the various tubes. A cross-bar attached to an overhead cable running over pulleys to a counterweight is next lowered on the radiator and attached by means of links to a hook on each side of the ram, this cross-bar having ribs which run between the tube ends. After the connections have been made, a valve on the bench is operated to admit air into the cylinder of the ram. This pulls the ram, links, and cross-bar down and draws the upper tank part down on the top fin.

Assembling the lower tank cover is the work of the fourth man. The cover edges are inserted between the upright edges of the plate which was assembled with the fins. These edges are then hammered down all around the cover and soldered. The fifth man solders all the tube ends projecting through the upper tank, as shown in Fig. 10. In this operation, the entire surface of the tank adjacent to the tubes is covered with solder and the gooseneck inlet connection, known as the "overflow pipe," which is shown attached to the upper tank, is also soldered fast. The final soldering steps consist in assembling the cover of the upper tank. It is soldered along the sides and at both ends, where a flap on the tank proper is bent against the cover. This job is really divided between two men, the first putting the cover in place and hammering the edges down, while the man at the next station does the actual soldering.

Testing the Radiators for Water-tightness

Preparatory to testing the radiator, a cap is screwed on the filler tower, and the inlet pipe to the upper tank is plugged, after which the radiator is immersed in a water tank, as shown in Fig. 12, and a compressed air line connected to the outlet of the bottom tank, in order to blow air through the various tubes of the radiator to the upper tank and then through the overflow pipe. Should there be any leaks in the radiator air bubbles will rise to the surface of the water through the leaks. In that case, the workman pries apart the fins to get at the leaks, and solders them until the radiator is absolutely water-tight. The tank rests on concrete piers, and has a glass bottom beneath which electric lights are placed so that it is very easy to see through the radiator during the test. Easy observation of the radiator is also arranged for by having the water constantly flow in and out of the tank to keep it clear, and free it from acid that would attack the hands. During the

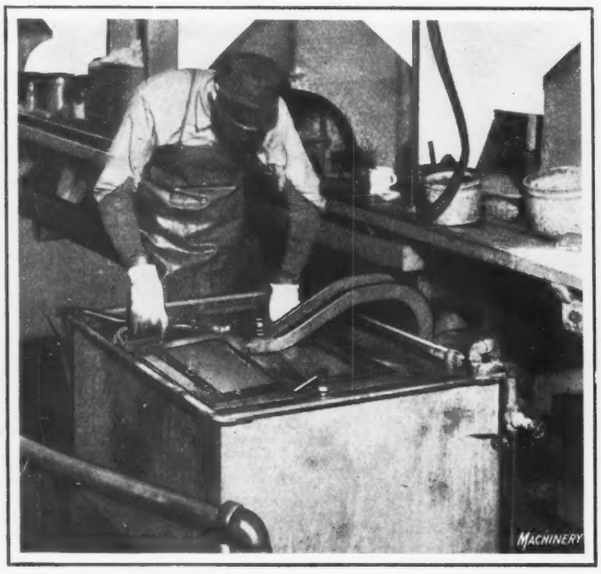


Fig. 12. Testing the Water-tightness of the Radiator

Fig. 13. Final Operation on the Assembling Track

time that the radiator is in the tank of water the traveling jig is on a portion of the track which may be raised and lowered at will. Its weight is balanced by a corresponding weight acting through a lever which allows the radiator and fixture to be dipped in and out of the tank as often as desired, with little effort on the part of the operator. Should a radiator have to be removed from the fixture before it is tested, the test may be accomplished by laying the radiator on iron strips placed in the tank for the purpose.

The final operation on the assembling track consists of straightening out irregularities in the fins and cleaning off excess solder. For this operation, the workman employs a hand tool, as shown in Fig. 13, having a three-pronged claw with a width between the prongs slightly greater than the thickness of a fin, so that the prongs may be pulled back and forth over two fins at one time to straighten and clean them. Lumps of solder that cannot be removed with this tool are twisted off by means of pliers. From this stage on the assembling track, the radiators are removed and transported to a stock-room, where they are held until desired in the chassis assembling department. Production on the assembling track averages 200 radiators per day. Various parts, such as the outlet pipe, are assembled to the upper and lower tank stampings before being delivered to the assembling track.

* * *

SIMPLIFIED BEAM AND TRUSS FORMULA

By MALCOLM P. DAVIS

The formula given in the accompanying table for determining the safe load of beams and trusses is a close approximation that is convenient in machine design because of its simplicity and because the strength of all sections generally used can be calculated by means of the same formula. In order that the user may be sure that this formula is based on proper theoretical considerations, its derivation will be explained. In strength of materials, the following is the general formula for a simple beam uniformly loaded and supported at both ends:

$$\text{Safe load} = \frac{\text{fiber stress} \times \text{section modulus} \times 4}{\text{½ beam length, in inches}}$$

For section modulus in this formula substitute

$$\frac{\text{Area of section} \times \text{depth of beam} \times \text{constant}}{4}$$

which gives

$$\text{Safe load} = \frac{\text{fiber stress} \times \text{area of section} \times \text{depth of beam} \times \text{constant}}{\text{½ beam length, in inches}}$$

which corresponds to the formula given in the table.

The method here used for finding the section modulus of a section is not the one customarily used in strength of materials, but it gives a close approximation for any given shape, regardless of the area of the section or the depth of beam, and for some shapes it gives the exact value found by the standard formulas. It is upon this fact that the formula in the table is based.

The constants in the table can be determined by means of a formula obtained by simply transposing the expression substituted in the common safe-load formula for the section modulus. Thus

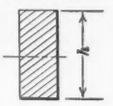
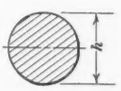
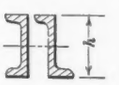
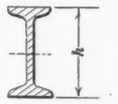
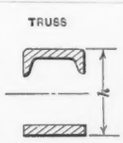
$$\text{Constant} = \frac{4 \times \text{section modulus}}{\text{area of section} \times \text{depth of beam}}$$

For use in this formula, the section modulus for any given shape can be calculated or taken from a table. It will be found that for some shapes there are variations in the value of the constant, and in such cases a mean value must be taken. This variation represents the amount of error in the formula. The constant for the first two sections in the table gives the same results as the regular formulas used in strength of materials, while for the other sections the constant gives sufficiently close results.

If a beam of considerable depth, or one with a very thick web, is being calculated, the result will be more nearly correct if the strength of the web is found by using the formula with the first constant in the table, and the strength of the flanges by using the formula with the last constant, the two results then being added to obtain the total strength of the beam. No constant is given in the table for a box section, but the strength of a beam of this design can be figured out by using the formula with the first constant for finding the strength of the sides, and then with the last constant for the purpose of determining the strength of the top and bottom between the sides, finally adding the two results together.

Instead of working the web and flanges separate and adding the results, the formula may be stated as follows,

FORMULA AND CONSTANTS FOR CALCULATING APPROXIMATE STRENGTH OF BEAMS AND TRUSSES

Section	C Load at Center	C Uniform Load	Formula
	0.333	0.666	$L = \frac{P \times a \times h \times C}{d}$ in which L = safe load; P = allowable fiber stress, pounds per sq. in.; a = area of section; h = depth of section; C = constant in table; d = one-half length of beam. If load is not in center of beam, use formula for both values of d, add the results and divide by 2. For cantilever beam, divide result obtained from formula by 2.
	0.250	0.500	
	0.250	0.500	
	0.570	1.140	
	0.650	1.300	
TRUSS 	0.900	1.800	

Machinery

in which A = area of web and a = area of flange. Then

$$L = \frac{Ph}{d}\ (A \times 0.666 + a \times 1.82)$$

The last constant for a truss approaches 2 for an evenly distributed load as the depth of the truss increases. This formula can also be used for a beam not loaded at the center by employing the formula twice with the different values of d, adding the results and dividing by 2. If the result is divided by 2, the formula is also satisfactory for determining the strength of cantilever beams.

* * *

The service of the Engineering Societies' library at 29 W. 39th St., New York City, has been extended so that in the future, books may be lent to members of the four national engineering societies—the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society of Civil Engineers, and the American Institute of Mining and Metallurgical Engineers. By the new arrangement, members living at a great distance from the library are permitted to obtain loans of books directly from the library.

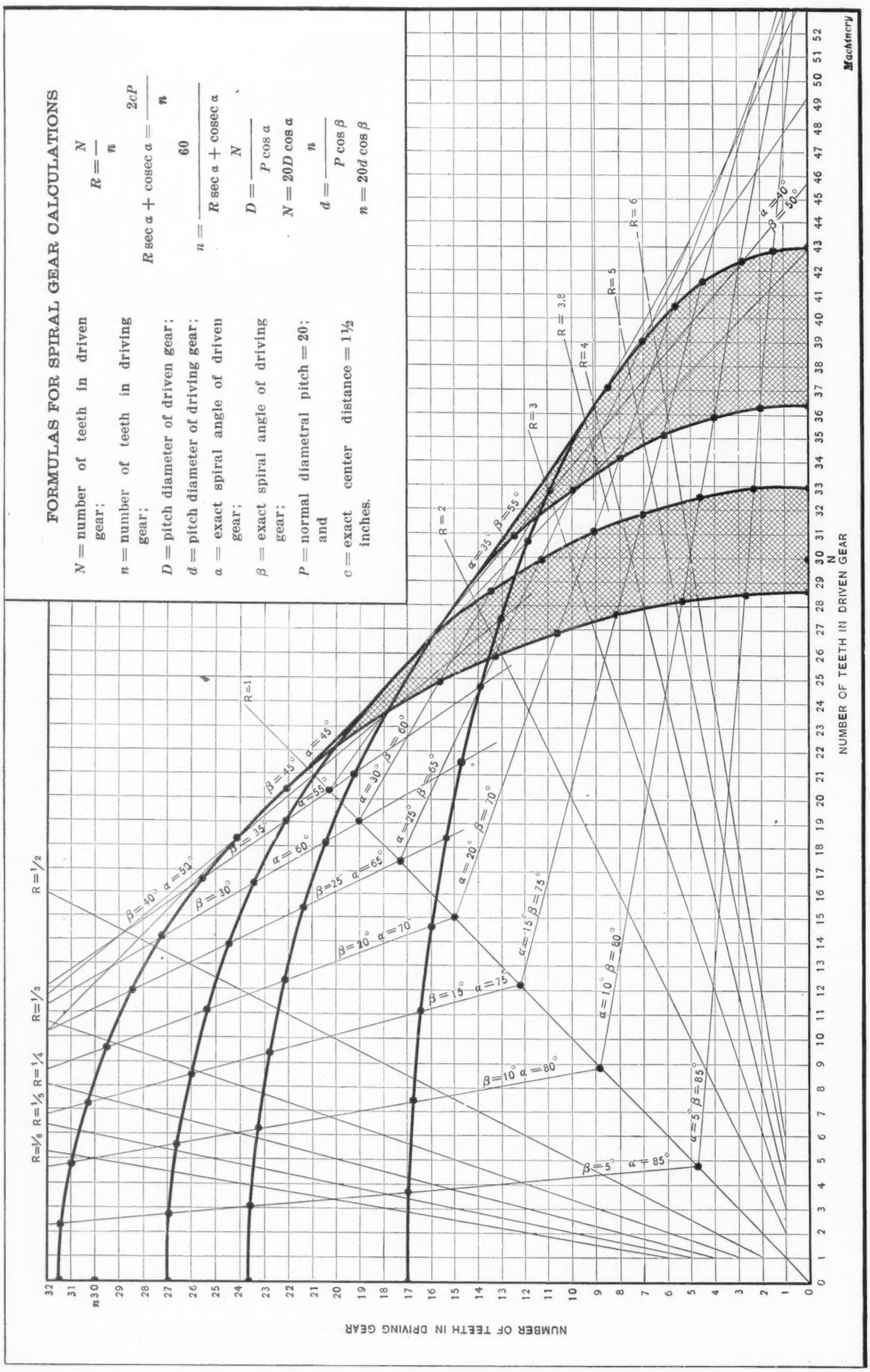


Chart for Use in designing Spiral Gears

Chart for Designing Spiral Gears

By T. C. CAMPBELL, Designing Engineer, Western Electric Co., New York

WHERE spiral gears of a number of ratios are likely to be required for gear-cases, the dimensions of which remain fixed, a chart similar to the one here reproduced is very useful, as it shows at a glance all the possible gear combinations that may be used, together with the number of teeth and the approximate spiral angles of all the gears of any combination that may be selected. The construction of such a chart is quite simple, and its use will save considerable work. Since it shows diagrammatically the relation of any gear combination to all the other possible gear combinations, there is never any doubt, in using it, that the best set of gears has been selected for the required purpose.

TABLE 1. RELATION BETWEEN SPIRAL ANGLE OF DRIVEN GEAR AND NUMBER OF TEETH IN DRIVING GEAR

α	n	α	n	α	n
5	4.80	20	15.00	35	20.20
10	8.88	25	17.29	40	20.95
15	12.25	30	19.00	45	21.20

Machinery

This particular chart was made to serve as an aid in the design of the gears for a device driven through two countershaft gears, mounted at right angles to the driving and driven gears. The center distance between each pair of gears is fixed at 1½ inches and only 20-pitch gears are used. Owing to the limitations imposed by the gear-case, and other limitations in the gears, the pitch diameters of these gears must be held within the following limits:

Driving gear.....max. 1.57 inches min. 1.35 inches
First countershaft gear...max. 1.65 inches min. 1.43 inches
Second countershaft gear..max. 1.18 inches min. 0.85 inch
Driven gear.....max. 2.15 inches min. 1.82 inches

TABLE 2. RELATION BETWEEN PITCH DIAMETER AND NUMBER OF TEETH

Diameter d, Inches	Number of Teeth n	Diameter D, Inches	Number of Teeth N
1.57	31.4 cos β	2.15	43.0 cos α
1.35	27.0 cos β	1.82	36.4 cos α
1.18	23.6 cos β	1.65	33.0 cos α
0.85	17.0 cos β	1.43	28.6 cos α

Machinery

In making the chart, the ratio lines $R = 1/6$ to $R = 6$ were drawn on coordinate paper, where the abscissas are shown as the number of teeth in the driven gear and the ordinates as the number of teeth in the driving gear.

The relation between the angles α and the number of teeth n for different ratios, as indicated by the points marked off on the $R = 1$ line of the chart, were determined by the formulas

$$R \sec \alpha + \operatorname{cosec} \alpha = \frac{2cP}{n}$$

and

$$n = \frac{60}{R \sec \alpha + \operatorname{cosec} \alpha}$$

Table 1 gives the relation between angle α and the number of teeth n as calculated.

Then through these points, by using a protractor, were drawn their respective angle lines. From the formulas

$$D = \frac{N}{P \cos \alpha} \quad \text{and} \quad d = \frac{n}{P \cos \beta}$$

were derived the following:

$N = 20D \cos \alpha$, and $n = 20d \cos \beta$, respectively.

By substituting for D and d in these formulas the maximum and minimum pitch diameters given in the foregoing, it was found that the relation between the pitch diameter and the number of teeth is as shown in Table 2. Then with one setting of the slide-rule for each gear, the relationship between the pitch diameter d of the driving gear, the number of teeth n, and the angle β, was found to be as given in Table 3.

In the same manner, the relationship between the pitch diameter D of the driven gear and the number of teeth N was found to be as given in Table 4. Curves plotted in accordance with the information given in Tables 3 and 4 out-

TABLE 3. RELATION BETWEEN PITCH DIAMETER, NUMBER OF TEETH, AND SPIRAL ANGLE OF DRIVING GEAR

Diam. d	1.57	1.35	1.18	0.85
β Degrees	Number of Teeth n			
0	31.40	27.00	23.60	17.00
5	31.30	26.90	23.55	16.95
10	30.90	26.55	23.20	16.75
15	30.30	26.09	22.80	16.42
20	29.45	25.35	22.18	15.99
25	28.45	24.44	21.40	15.40
30	27.20	23.40	20.43	14.70
35	25.70	22.10	19.30	13.90
40	24.05	20.70	18.10	13.02
45	22.20	19.10	16.70	12.00

Machinery

line the areas within which all the possible gear combinations fall.

Only the shaded areas are used in the design of the gears for the device for which this chart was made, as only the corresponding reductions in speed are required. In using the chart, the required ratio is divided into a ratio for each pair of gears, since there are two pairs of gears used. On these resulting ratio lines are picked the points of intersection of the coordinates. These coordinates give the number of teeth for each gear. The approximate spiral angle for each gear may also be determined by noting the location of these points with reference to the angle lines on each side of them.

As an example, one ratio required is a 36 to 1 reduction. This is divided into a 6 to 1 ratio for each pair of gears.

TABLE 4. RELATION BETWEEN PITCH DIAMETER, NUMBER OF TEETH, AND SPIRAL ANGLE OF DRIVEN GEAR

Diam. D, Inches	1.65	1.43	2.15	1.82
α Degrees	Number of Teeth N			
0	33.0	28.6	43.0	36.4
5	32.9	28.5	42.8	36.3
10	32.5	28.2	42.5	35.9
15	31.8	27.6	41.6	35.2
20	31.0	26.8	40.4	34.2
25	29.9	25.9	39.0	33.0
30	28.6	24.8	37.2	31.5
35	27.0	23.4	35.2	29.8
40	25.3	21.9	32.9	27.9
45	23.3	20.2	30.4	25.7

Machinery

From the chart it is seen that the gears of the first pair have 5 and 30 teeth, respectively, and that their respective spiral angles are slightly over 80 degrees and slightly less than 10 degrees. Those of the second pair have 6 and 36 teeth, while their angles are less than 75 degrees and over 15 degrees, respectively.

The exact spiral angles may then be determined in the usual way or from the formula:

$$R \sec \alpha + \operatorname{cosec} \alpha = \frac{2CP}{\pi}$$

If gears of more than one pitch must be used to meet the required conditions, it is not necessary to draw a new chart each time gears of a new pitch are needed. It is much simpler to use the same curve, and to change the scale of the coordinates to represent the new pitch. After a little practice, it will not be necessary to draw the new coordinates at all, as their location may be estimated accurately enough. As an example, the accompanying chart shows that it is impossible to get a 3.8 to 1 reduction with the second pair of gears, where the pitch is 20, as gears of 10 and 38 teeth fall outside the shaded area. To determine the pitch that shall be used, the points N and n are located on the chart, N and n each being equal to cP. Now if P' for the new pitch required is made to equal $P + 2$, and N' and n' each equals cP', then N' and n' each equals $cP + 2c$ or $N' = N + 2c$ and $n' = n + 2c$.

If the new points N' and n' are made to coincide with the first points N and n, 33 coordinates will be required in the spaces 0 to N and 0 to n, instead of 30. By using the new coordinates, it will be seen that gears of 22 pitch, having 10 and 38 teeth, would fall within the shaded area on the $R = 3.8$ line.

* * *

SOLVING SOME PROBLEMS OF A SHEET-METAL JOBBING SHOP

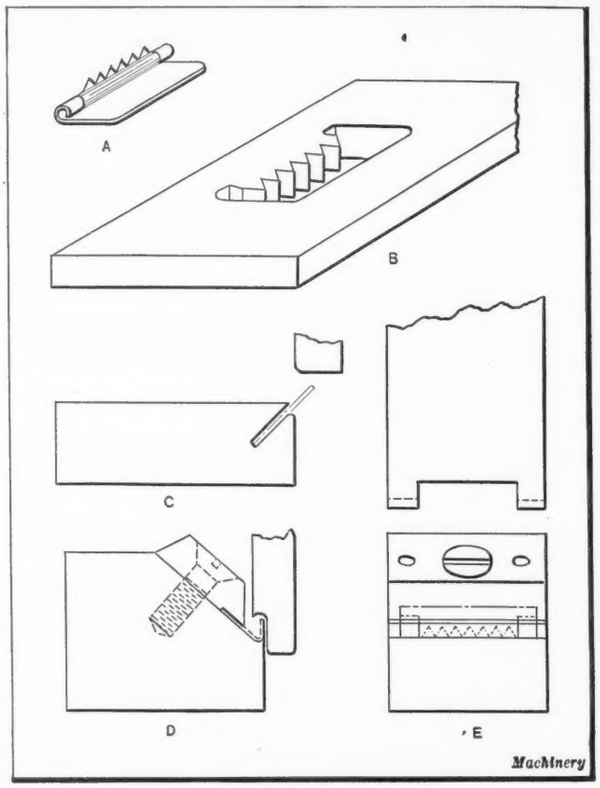
By S. A. McDONALD

The sheet-metal jobbing shop has to deal with two types of customers—those who know exactly what they want, and those who have ideas but who have not worked out any of the details or design of the thing they want made. The former generally submits a sample or blueprint of the part desired, and may ask for quotations on the necessary tool equipment and a price on lots ranging from 10 to 1000 pieces. The latter type generally has but a slight knowledge of mechanical subjects, and expects to have his ideas carried out from verbal instructions. This is usually unsatisfactory to both parties. The customer does not realize that the manufacturer may have to spend considerable time and money in developing the design or working out details before actual production can begin, and often he refuses to pay for this service. Again, misunderstandings sometimes arise owing to the fact that the customer seldom realizes that a slight change in the design may necessitate a considerable change in the tool equipment, resulting in additional expense for tools.

Both types of customers must, of course, be given courteous attention. The most peculiar inquiries sometimes lead to the establishing of a profitable business. Sometimes an order for a single part later brings an order for thousands of pieces. The following may be cited as an instance of this kind. One day a man came into a shop engaged in sheet-metal jobbing work, and left an order for a single piece made from "shiny brass" of the design shown at *A* in the illustration. The piece was made up to conform with the size and shape of a paper model which the man supplied. The customer called for the part next day and was charged $2 for it. About a month later the same customer returned and wanted a price on 100 parts like the one previously made up for $2. The foreman of the shop submitted a price of $20 for 100 parts, or $40 for 1000 pieces. The latter quotation surprised the customer somewhat, and he left an order for 1000 pieces. The price quoted did not, of course, allow much for tool work, but the foreman did all the tool designing and already had a good idea of what tools would be needed.

The tool equipment that was made up to handle this job consisted of a blanking die *B*, made of tool steel, a punch and forming tool *C*, and a curling die *D*. The opening in the die *B* was made by drilling holes through the piece and then filing the opening to the shape shown. The punch for this die was laid out from the opening in the die, and sheared through the opening after being machined nearly to size. The die *B* was clamped over a plate having a hole in it large enough to permit the punchings to fall through into a box located under the die.

The forming tool shown at *C* is simply a block of cold-rolled steel having a slot milled along one corner with its

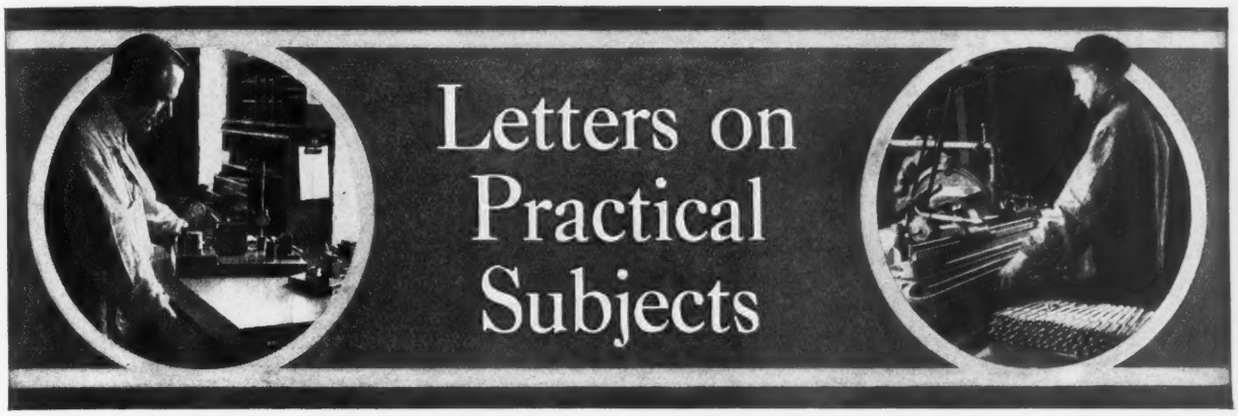


Punch Press Tool Equipment used in Jobbing Shop

lower edge slightly rounded. The piece is bent over this rounded edge by another piece of cold-rolled steel clamped in the slide of the press. The die shown at *D* and *E* which curls the two end legs of the piece *A* was also made from cold-rolled steel. A plate attached to the beveled edge of this curling die serves to prevent the work from backing away from the curling punch. The direct labor cost of producing these tools was about $15, and as the material from which they were made came from a scrap bin, the total tool cost was kept very low. As the sheet brass stock required for 1000 pieces cost only $2, a good margin was left for overhead and profits. It might be of interest to mention here that repeat orders for 1000 of these pieces came in every month, so the foreman ordered the pieces made up in lots of 10,000.

* * *

At a recent demonstration before members of the American Institute of Electrical Engineers at the high voltage laboratory of the Westinghouse Electric & Mfg. Co., in Trafford City, Pa., an electric arc of 42 feet was formed at a potential of a million volts. This is the largest controlled arc ever made artificially. Photographs were taken of the electrical phenomenon. The test room was in entire darkness during the experiment, and the flashes of the arc photographed themselves on an exposed camera plate.



RESHARPENING MILLING CUTTERS

Investigation of broken milling cutters of slender or delicate form, when broken under ordinary cutting conditions, will almost invariably reveal a chip-loaded flute. This chip-loading is caused in a large measure by the roughness of the flutes of the cutter, which are not usually ground on the lip or radial surface. No lathe operator would think for a moment of using a tool which did not have all its surfaces that are presented to the work properly ground, and perhaps honed if he desires to do first-class work. It would seem just as important for slender milling cutters, such as end-mills, which are unsupported at one end and must work under the least favorable conditions, to have all their cutting faces sharpened. To insure the best results from the standpoint of finish, minimum breakage, and economy, the cutting faces should not only be sharpened, but sharpened so as to leave a fine edge that is as free as possible from the "saw-tooth" condition that is produced by too hurried sharpening or the use of too coarse a wheel.

As a step in obtaining superior cutting edges on slender mills, the double collet shown in Figs. 1 and 2 was designed. The primary purpose of this collet is to facilitate sharpening by the use of a substantial finger. This is difficult, and even impracticable in many cases, owing to the small space between the flutes, except as resort may be had to an auxiliary guide of the kind here illustrated.

The collets *A* and *B*, Fig. 1, are of the familiar type used on milling machines for holding small end-mills. The guide cutter or blank *C*, which is placed in the collet *A*, must be brought into the correct position in relation to the cutter *D* which is being sharpened. The guide finger *E* must also be properly set for height and position of stroke. It will be noted that the cutter being sharpened may have its cutting edge upward when fed against the wheel in a direction opposite that in which the wheel rotates. This is the condition best suited to the production of a good edge. The guide finger *E* will then come on the back side of the guide cutter *C* as shown.

In actual practice, it may be found that the flutes of some cutters do not "track" with the guide cutter. This may be true especially of spiral-fluted mills. In this case the best procedure is to use a master guide in resharpening all the cutters of one kind. This method will correct all inaccuracies that arise from distortion in hardening, careless or faulty milling and similar causes. For sharpening the flutes on the radial or lip surfaces, the formed wheel should have a slightly sharper angle than that of the cutter used in milling the flutes, and it is preferable that it be a little smaller in diameter.

Springfield, Vt. O. S. MARSHALL

ROD AND WIRE CUTTING-OFF DEVICE

The cutting of small round rods or wire into short lengths to form dowel-pins is generally done either on an automatic screw machine, a hand screw machine, or a bench type of wire cutter. In Fig. 1 is shown a side elevation, and in Fig. 2 a top view of an automatic device designed especially for this kind of work. This device has proved satisfactory for cutting off dowel-pin stock up to 3/16 inch in diameter. It occupies but little floor space and can be set up in line with the automatic screw machines and kept stocked up and running by one of the screw machine operators.

A feed magazine consisting of a 14-foot length of 1-inch steel tubing is suspended from the ceiling directly above the guide bushing *A*, Fig. 1. The rod to be cut is placed inside this tubing and is fed down to the stop *B* by its own weight. It is cut off by the revolving cutter *C*. In changing from one size of wire to another, it is only necessary to change the guide bushing and adjust the stop *B* to give the required length of pin.

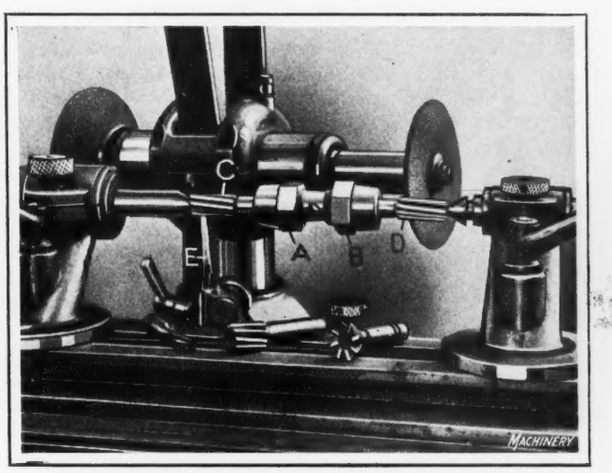


Fig. 1. Double Collet used in sharpening Milling Cutter

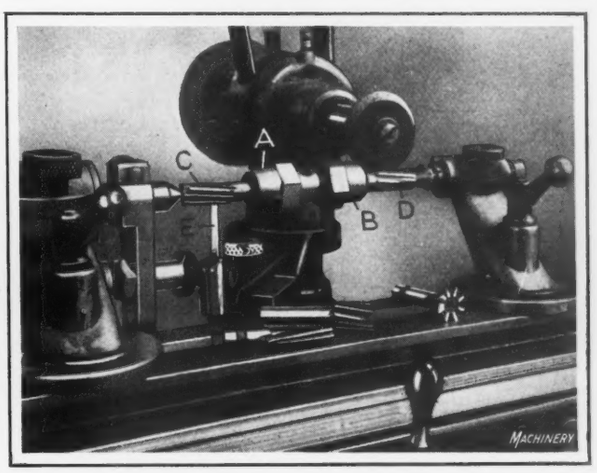


Fig. 2. Set-up used in grinding Lands of Milling Cutter

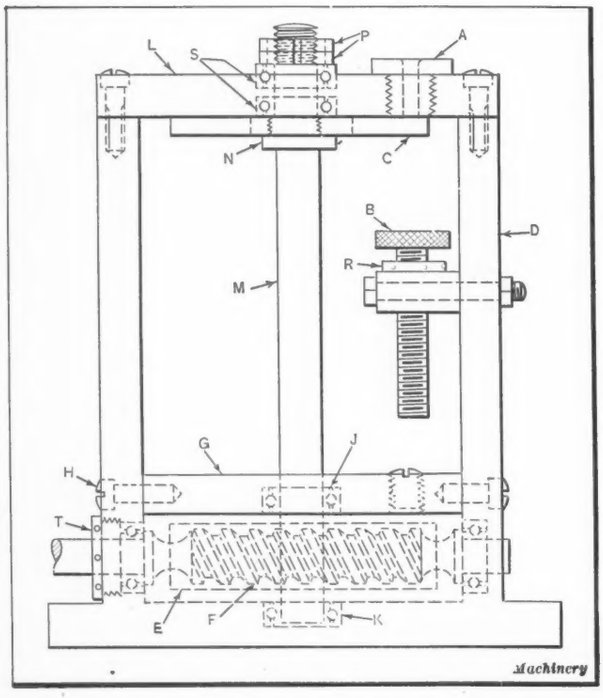


Fig. 1. Device for cutting off Wire and Rods to form Dowel-pins

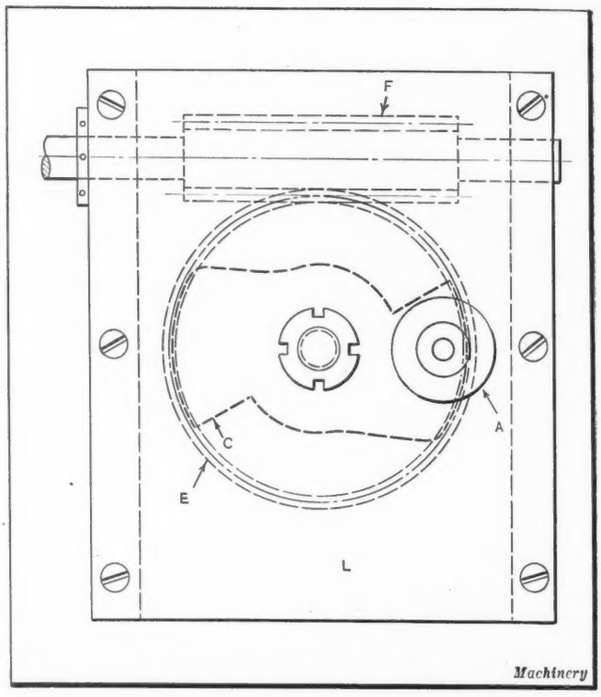


Fig. 2. Top View of Cutting-off Device shown in Fig. 1

The body or frame *D* of the device is an iron casting with a gear-box at its base. The base is laid out so that the gear *E* and worm *F* are properly meshed, with a clearance of about 0.002 inch. The cover *G* is made of ½-inch machine steel, and is a tight fit over the gear-box. It is drilled and tapped to receive the machine screws *H*, and is also machined to receive the shaft bearing *J*. Care should be taken to see that the hole for this bushing is drilled in accurate alignment with the lower bearing *K*.

The upper guide plate *L* is a piece of ¾-inch machine steel, and is fastened in place by machine screws, as indicated in Figs. 1 and 2. This plate is drilled and reamed to receive the ball bearings that support the upper end of the cutter-spindle *M*, Fig. 1, and is also drilled and tapped to receive the guide bushing *A*, which is made from 1-inch hexagonal tool steel. This bushing must be hardened and ground, as its lower end serves as one of the knives for cutting off the rod or wire. The driving gear *E* is made from a bronze casting, 4 inches in diameter by 1 inch thick, and is keyed to shaft *M*. The worm *F* is made of tool steel, and is hardened and drawn. It is 1 inch in diameter and is mounted in standard ball bearings, as indicated.

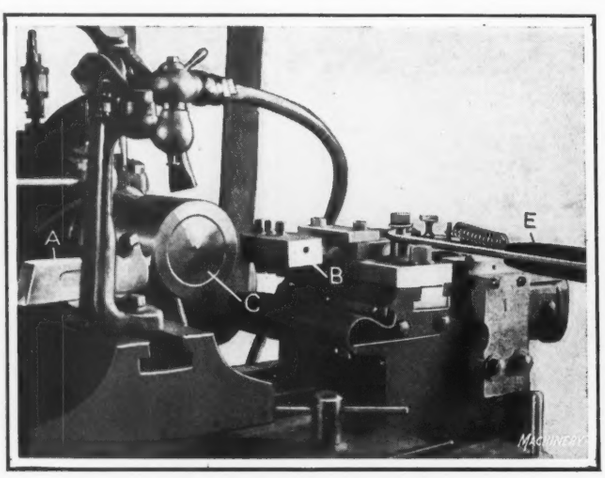
The cutter-spindle *M* is made from 1-inch machine steel, and is turned down to a diameter of ¾ inch up to the shoulder *N*. The bottom end of the spindle is made a snug fit in the ¾-inch hole in gear *E*, to which it is keyed. A ¾-inch thread is cut next to the collar *N* to fit the threaded hole in cutter *C*. The lock-nuts *P* are employed to adjust the amount of end play of spindle *M*. Stop *B* is provided with a lock-collar *R*, which can be tightened to hold the stock in place after the adjustment is made.

The revolving cutter *C* is made from a piece of ⅜-inch tool steel, and is carefully hardened and drawn. Referring to Fig. 2, it will be noted that this part has two cutting edges, so that two pins are cut off at every complete revolution of the cutter-spindle. The packing-box nut *T*, Fig. 1, is made from 1¼-inch hexagonal brass stock, and serves to prevent oil leakage from the gear-box. In assembling the device, it is a good plan to put enough transmission oil in the gear-box to cover the gears before fastening the cover *G* in place. After the worm and worm-gear are assembled and cover *G* is fastened down, the upper plate *L* which carries the ball bearings *S* can be put in place. The cutting-off device here described is entirely automatic in operation, and can be driven from the lineshaft or by a ¼-horsepower motor. Very good results have been obtained by driving the device at a speed of 80 revolutions per minute from a pulley mounted on the lineshaft.

Cicero, Ill. JOHN J. BORKENHAGEN

MACHINING WEIGHTS FOR BALANCE SCALES

Weights used for the balance type of scales have their bases recessed so that some heavy metal, such as lead, can be added to obtain the exact weight desired. The illustration shows a special machine set up for turning, facing, and recessing these weights. The work is held on a threaded stud which fits a hole previously machined in one end. The tool *A* is used for turning the weight to the required diameter.



Machining Weights for Balance Scales

During the turning operation a tool carried in the rear tool-block *B*, which is controlled by a former plate, machines the end *C* of the weight and forms the recess as shown. The end-facing tool is fed against the work by manipulating the handle *E*. The contour of the forming block may be changed to give the desired shape to the recess or bottom of the weight. After the machining

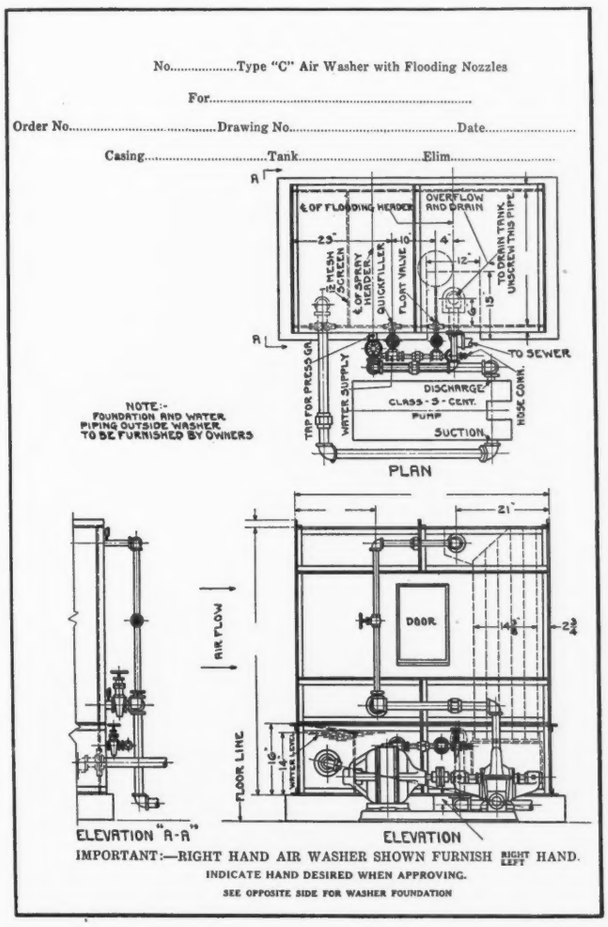


Fig. 1. Printed Form on which Special Dimensions can be typed

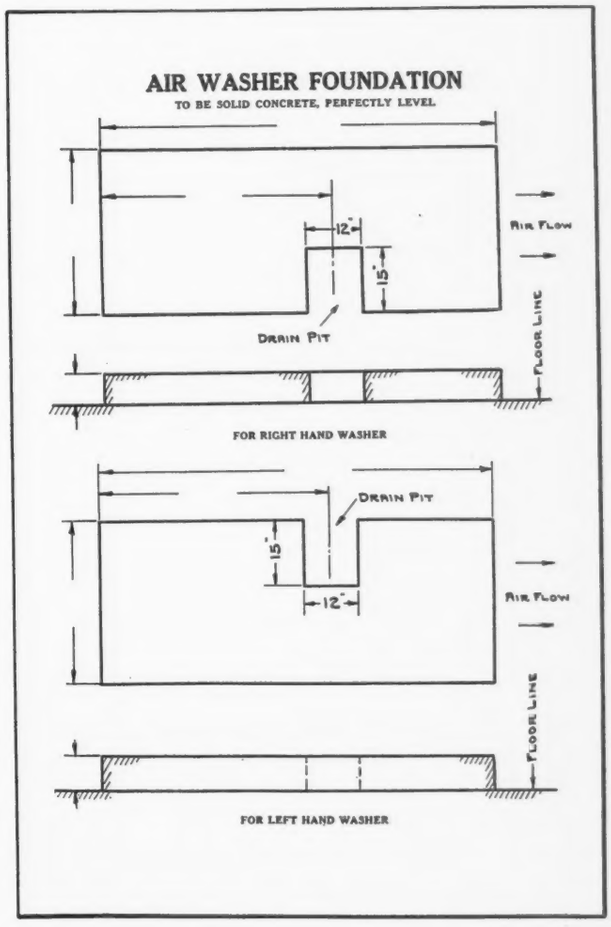


Fig. 2. Printed Form showing Foundation Plans

operations, the steel weights are ground in order to give them a smooth finish and bring them as near as possible to the desired weight, which in this case is exactly 10 pounds.

Providence, R. I. ROBERT MAWSON

LABOR-SAVING METHOD OF PRODUCING DRAWINGS AND SPECIFICATIONS

The method of producing drawings and specifications for special machinery or machine installations described in this article was developed by the writer for use in a plant manufacturing air conditioning equipment. The method has been in use for some time and has given excellent results. With only slight modifications it can be adapted to the requirements of many manufacturing plants. In the plant where the method is in use, only about ten types of units are made, but each type is furnished in from one to two hundred sizes. About 25 per cent of the orders received by this plant contain specifications that require certain changes in the standard product. If a separate drawing for each size of machine and for each special order were to be made up in the usual way, it is evident that quite a large drafting force would be required, whereas only a comparatively small number of draftsmen are needed when the method here described is employed.

In Fig. 1 is shown what may be termed a "white print," on which is placed all the information required by the purchaser in erecting the machine or unit. On the back side of this print, as shown in Fig. 2, is a printed outline of the foundation plans for the unit with blank spaces for filling in the required dimensions. By using a typewriter and carbon paper, the required dimensions can be filled in on several copies of these printed forms at one time. At least five legible copies of white prints can be made in this way. Any special notice or information can also be typed on these prints at the time the dimensions are filled in.

Time is also saved in preparing blueprints for use in the shop, when manufacturing special machinery or equipment, by having a master tracing with blackened spots where the dimensions are to appear. The white spaces left on the blueprints or Van Dyke prints by these blackened spots are filled in by hand, thus eliminating the necessity for making an entirely new drawing. Hundreds of these prints can be made from one original tracing, and each print can be filled in to represent a different size or unit. Each of these prints can then be placed in a file ready for immediate use in making as many blueprints as may be required for production

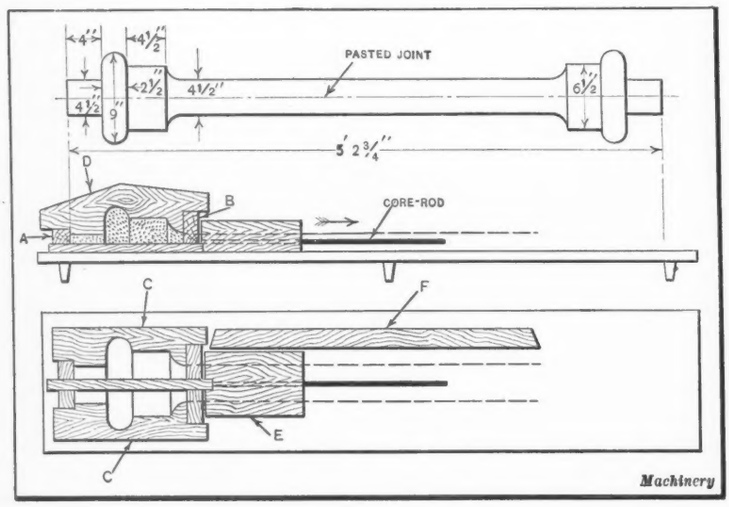
Order No..... Sheet No.....

BILL OF MATERIAL FOR ONE TYPE.....WASHER

FURNISH FOR.....WASHERS

No.	Sizes	Name of Part	Material
—		Stand pipe caps	
—		Flooding header cap	
—		Stand pipes tapped for nozzles	Extra heavy
—		Flooding header tapped for nozzles	
—	1¾" x 3/16"	Spray nozzles	Brass
—	2 5/16" x 3/16"	Flooding nozzles	Brass
1—	1/12" mesh	Suction screen	Brass

Fig. 3. Bill of Material that can be filled out in Duplicate on Typewriter



Skeleton Core-box for making Half-cores

purposes. A few blank prints are always kept on hand to take care of the special sizes or units.

A bill of material or sheet of specifications which can be filled out on the typewriter in a few moments is attached to each blueprint or Van Dyke print. These specification sheets serve the double purpose of providing a list of the materials required in making up the order and a shipping list. The upper part of one of the specification sheets is shown in Fig. 3. The column headed "Sizes" can be filled in on the typewriter when the dimensions are special. For standard sizes the dimensions are printed on the specification sheet, as in the case of the 1 3/4 by 3/16-inch spray nozzles listed in the third line from the bottom. The same method is employed in the case of the column headed "Material." With the system described in this article only an hour or two at the most is required to prepare the drawings and list of materials and get the work under way, whereas with the methods previously employed it was several days, in many cases, before the drafting-room work was completed.

Buffalo, N. Y. L. H. GEORGER

MAKING A LONG SLENDER CORE WITHOUT USING A FULL CORE-BOX

An old pattern on which a few minor changes had been made was to be used in the production of a casting for experimental purposes. However, a new core was necessary, and as only one casting was required, it was naturally desirable to produce the core without constructing an expensive core-box. The method employed to avoid the making of a core-box should prove of interest to patternmakers and draftsmen, as it can be used in making many of the cores for which a full core-box is usually considered necessary. The shape and dimensions of the finished core that was required in this case are shown in the upper view of the accompanying illustration.

In the lower view of the illustration is shown the half-circle sweep ends *A* and *B*. The thickness of these end pieces is not important, except that it must be great enough to give the necessary strength. The small semicircular end *A* is made solid, while the larger one *B* has a semicircular hole cut in it of the same diameter as the core—4½ inches. The two side frames *C* are about ⅞ inch thick, and were cut out on the band saw to conform with the outline of the core. These pieces form what may be termed a skeleton core-box, into which sand is filled and then swept off by means of the strickle board *D*.

The skeleton section of the core-box is placed on an iron core-drying plate. Sand is filled in to a depth of about one inch. At this point one or two iron core-rods are laid on the bed of sand to give the completed half-core sufficient strength and stiffness to keep it from falling to pieces after the baking process. These rods extend the full length of the core, although in the illustration they are shown broken off near the center. The old core-box shown at *E* was taken from the shelves in the foundry. This core-box is 12 inches long and was originally intended for use in making half-cores 4½ inches in diameter. At the side of this box is a straightedge *F* which, like the skeleton core-box frame, is fastened to the iron plate with iron clamps.

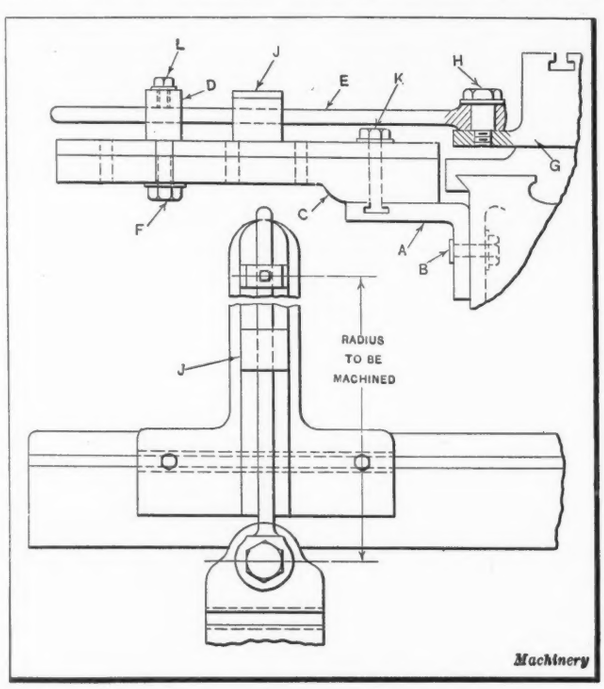
The core-box *E* is placed in position on a plate, as shown in the illustration, close up to the piece *B*. The core sand is filled into the box at the open end. After the box has been completely filled with sand, it is moved forward in the direction indicated by the arrow for a distance equal to about one-half its length. Core sand is again filled in at the open end to join that already molded to shape on the iron plate. This process of moving the core-box forward and filling it in with sand is continued until the slender section of the core has been completed up to the end of the straightedge *F*.

The skeleton core-box is then transferred to the right-hand end of the drying plate and employed to finish this end of the core. After completing the mold and smoothing it off, the iron plate with the half-core resting on it is placed in the baking oven. Two half-cores, made as described, are pasted together after they have been properly baked in the oven. The writer does not wish to be understood as advocating this method of making cores or molding for regular production work, but the method is being employed every day in different foundries under conditions that warrant its use, and it is well for the apprentice core-maker or anyone concerned with the production of castings to know as much as possible about the so-called "emergency methods."

Kenosha, Wis. M. E. DUGGAN

RADIUS-TURNING ATTACHMENT FOR LATHE

The radius-turning attachment shown in the accompanying illustration was designed for use in crowning pulleys, turning spherical sections for ball joints, and similar work. The various parts of the attachment consist of a cast-iron bracket *A* which is secured to the back of the lathe by two



Lathe Attachment for Radius-turning Operations

bolts, one of which is shown at *B*. The upper face of this bracket has a T-slot machined its entire length which fits the tongue on bracket *C*. Bracket *C* is held in place by two T-bolts, and has four ⅞-inch holes drilled along the center line of its projecting arm in order to provide adequate adjustment for block *D* which supports connecting-rod *E*. The bolt *F* which secures block *D* in place may be put in any one of the four holes drilled through arm *C*, depending upon the radius to which the work is to be machined. One end of rod *E* is clamped to the bottom slide *G* of the lathe saddle by the pin *H*.

The feed-screw of the bottom slide is, of course, disengaged from its nut when the radius-turning attachment is in use, the feed of the tool being accomplished by means of the top slide feed-screw. The block *J* has a slot milled on its under side that is a good fit over the rod *E*. As block *J* is the same width as the raised portion of bracket *C*, it is of assistance in adjusting the saddle so that bar *E* will be at right angles to the ways when setting the lathe tool. It is only necessary for the operator to adjust the lathe slide so that the sides of block *J* and the sides of the raised part of bracket *C* are flush in order that the tool may be adjusted when at the highest point of the radius.

In crowning a pulley, bracket *C* is first properly adjusted on bracket *A* and clamped in place by two T-bolts, one of which is shown at *K*. The rod *E* is then swung into the central position on a supporting bracket by moving the saddle until block *J* is lined up with the raised part of bracket *C*. The turning tool is next set in a central position between the sides of the pulley. Assuming that the pulley is to be crowned to a 16-inch radius, the bottom slide *G* is moved in or out until the distance between the center of pin *H* and set-screw *D* is exactly 16 inches. Bolt *F* and set-screw *L* are then tightened down. It is evident that any movement of the saddle along the lathe bed will cause the cutting tool to travel in the path of a circle having a radius of 16 inches.

W. WRIGHT

Horwich, Lancashire, England

DRAWING A DEEP BRASS PAN IN ONE OPERATION

The possibility of deep-drawing brass shells of irregular shape in one operation is exemplified by the brass pan shown in Fig. 1. When it was proposed to draw this pan in one operation, much opposition was encountered. However, the job was satisfactorily accomplished, as will be evident from the illustration. The pan is semi-oval and rectangular in outline, the finished depth being 2 13/16 inches. The material is soft-drawn brass, 1/32 inch thick, the corner radii being 19/32 inch and 1 11/16 inches, respectively, and the bottom radii 9/32 inch, as indicated in Fig. 2. The drawing was accomplished on a double-stroke Henderson press. A good quality of lard oil about the consistency of medium motor oil was used as a lubricant, and each blank was coated with this oil on both sides before drawing.

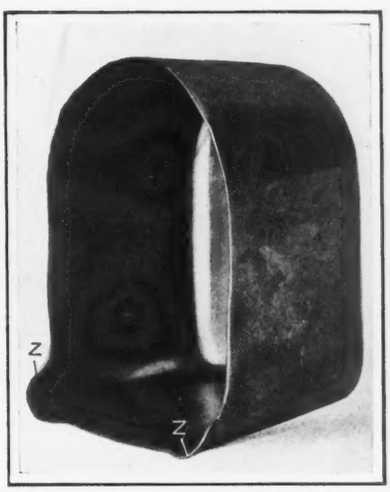


Fig. 1. Brass Pan which is drawn in One Operation

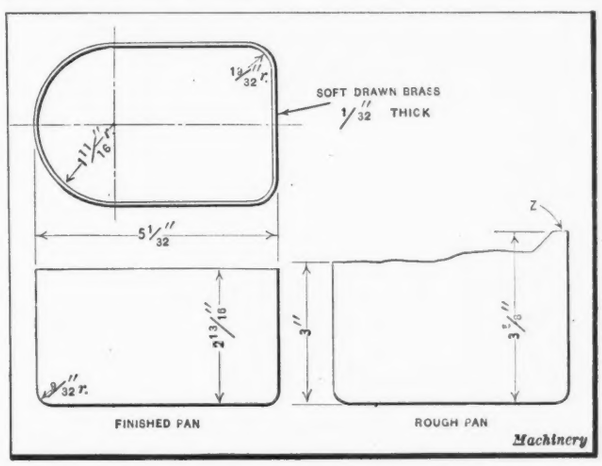


Fig. 2. Details of Pan shown in Fig. 1

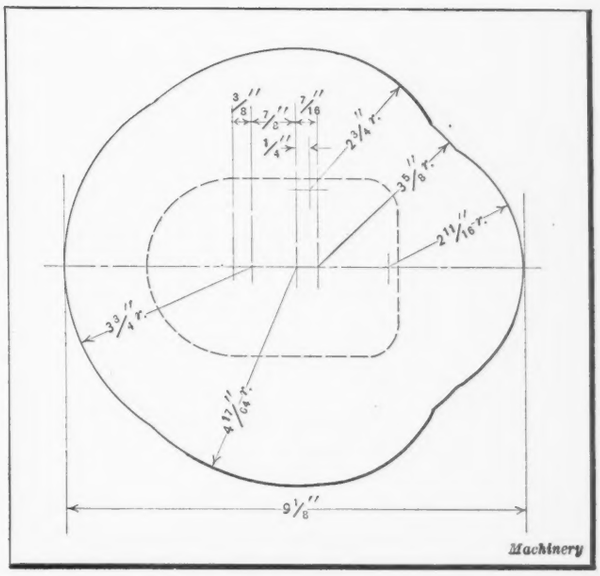


Fig. 3. Blank Outline for Drawn Pan

The approximate lay-out of the first trial blank was made according to the data in MACHINERY'S book, "Diemaking and Die Design." This lay-out proved a close approximation of the final blank outline, which is shown in Fig. 3. The first pan off the press was only about 1 inch in depth, and it could be plainly seen where the metal was pinched. The die was made with a 3/16 inch radius at *S*, Fig. 4, and the opening was made 0.010 inch larger than the outside dimensions of the shell. After the first trials, the radius *S* was increased to ¼ inch. This made the over-all dimensions 0.050 inch large at the top of the die. The original 0.010 inch full dimension was kept for ¼ inch up from the bottom of the die at *W* with a slight taper extending to the ¼-inch radius at *S*. These changes gave a freer draw, and after the contour of the blank had been changed to that shown in Fig. 3 the depth of the drawn shell was found to be 3 inches.

An odd point worth noting is the corners *Z* shown in Figs. 1 and 2, which may have a considerable excess of metal. The natural remedy for this would be to remove the metal at these points on the blank outline, but this proved unsatisfactory, as the metal would tear about 1½ inches from the bottom of the pan in being drawn. The outline as shown in Fig. 3 was therefore retained. The hold-down and die base *B* and *D*, Fig. 4, were made of cast iron, from the same pattern. The surfaces *F* were scraped and stoned to a mirror finish. Much attention was given to this point, as a small scratch or crevice would mar the work considerably. Dimension *M* was made ¼ inch greater over-all than *N* to allow the drawn pans to drop through the die base more freely.

The die was made of hot-rolled steel and pack-hardened. It was fastened to the die base with screws and dowel-pins. The punch *A* was made of cold-rolled steel and pack-hardened. It conforms to the inside dimensions of the

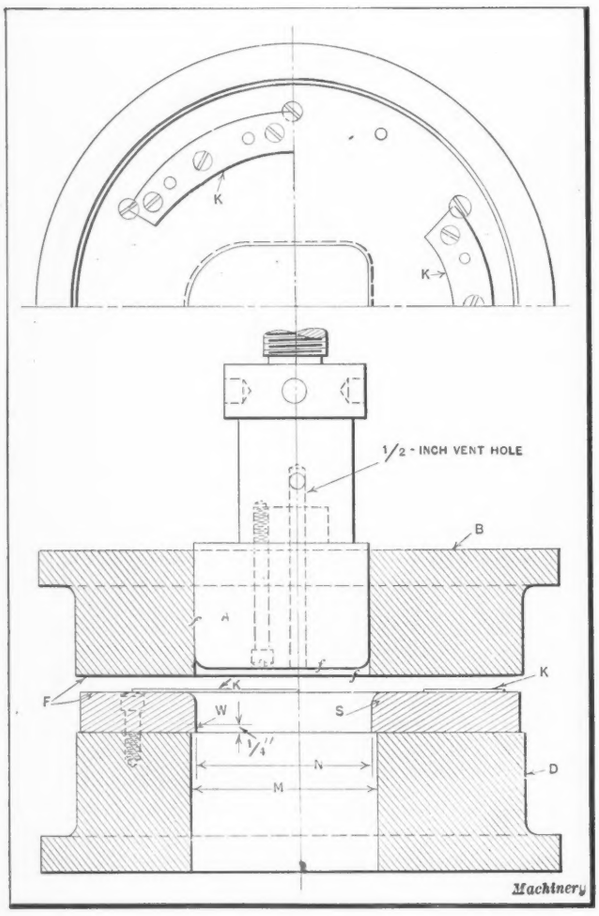


Fig. 4. Drawing Die used in the Production of Pans like the One shown in Fig. 1

pan, and was screwed and dowelled to a stud fitted to the press ram. The gage-plates *K* are located on the die as shown, and are made of cold-rolled steel, 1/32 inch thick. In conclusion, it may be interesting to note how the pan was trimmed. A quick-operating chuck was designed for a hand-operated turret lathe and the pan was faced to the required size with a tool held in the cross-slide. The production on this job averaged seventy pans per hour.

F. G. SCHUTZ and W. H. FREDRICK

Philadelphia, Pa.

DIE FOR PRODUCING METAL REINFORCING CLIPS

The die shown in the accompanying illustration has several features that may prove of interest to diemakers. It is designed to produce brass clips or clamps like the one shown at *M*. These clamps are made from brass strip stock 0.014 inch thick, which is of double width, so that two pieces are formed at each stroke of the single-action press. The clips are used to reinforce cardboard patterns that have become torn on the edges, as shown at *N*. The teeth of the clamp are pointed, as shown, so that they can be pressed through the cardboard and clinched.

The stock is fed into the die from the right-hand side of the opening *C*, which is so placed that two pieces are operated upon simultaneously, the dotted line *D* being the point of final separation. The opening *C* is made slightly longer than the length of one piece so that as the stock is passed along, the cut on each blank will overlap slightly on the next blank. This section is also made slightly wider in the center than at the ends to facilitate cutting off, which is done by a shearing cut at the left-hand end of section *E*.

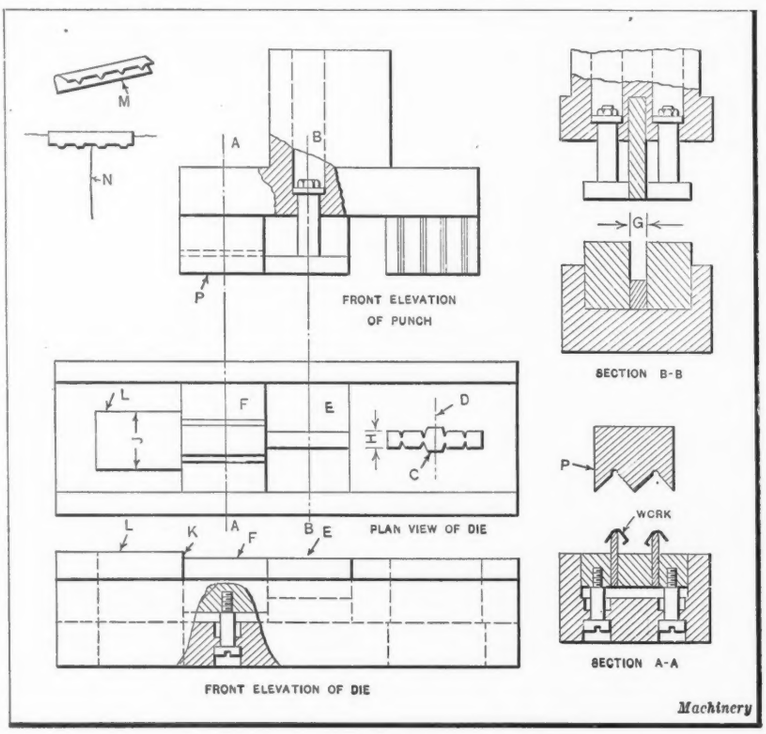
As the distance *G* shown in section *B–B* is exactly the same as distance *H* in the plan view of the die, it would be necessary to locate the stock exactly central on the part *F* in order to cut it off, if the central portion of the die opening at *C* were not made wider than the end section. The die section *E* is employed to bend the teeth of the clamp at right angles to the side. A pressure pad is located on each side of the punch, as shown in section *B–B*. The part *F* produces the final bend in the work. This member, which is shown in the cross-sectional view *A–A*, sinks into the die-holder as the punch descends, and is normally held up by springs—not shown—the tension of which causes a partial forming of the bend until the member bottoms in the holder, at which time the final bend is made. The punch *P* forms the final bend in the work, and at the same time serves as a shear, severing the stock at the left-hand end of section *E*.

The unusual shape of the punch is necessary in order to shear and form the work at one stroke. By permitting section *F* to recede into the holder, the cutting edge of punch *P* is allowed to pass the cutting edge of die *E*. When the work is cut off and formed, it rests on the member *F*, as shown in the sectional view *A–A*, and is then in position to be pushed further to the left by the advancing stock. The part *L* does no cutting, the opening merely permitting the work to drop through the die. This section is made slightly higher than the other sections, while the distance *J* is slightly less than the width of the stock. The step at *K* acts as a stop for locating the stock. When the final bend is formed, the work will clear this step and may then be pushed into the opening in the section *L* and out through the bottom of the die-holder.

Philadelphia, Pa. R. H. KASPER

* * *

At the present time the Patent Office is receiving 9000 applications a month. The records show that in times of business depression the number of applications filed are much greater than in times of industrial prosperity.

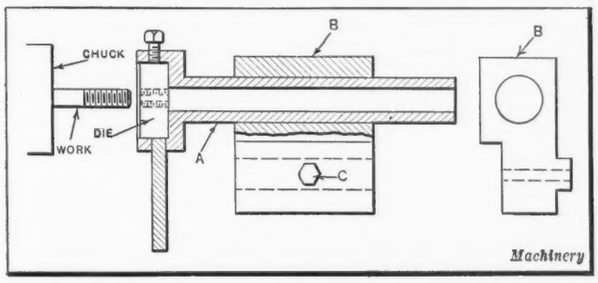


Die for producing Reinforcing Clips

Shop and Drafting-room Kinks

DIE-HOLDER FOR THREADING WORK IN A LATHE

The device illustrated is intended for use in cutting screw threads in the lathe by means of a die. The die-holder *A* is a sliding fit in the supporting block *B*. Block *B* is held



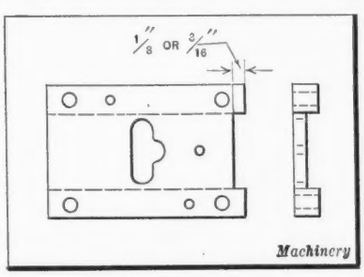
Method of cutting Threads in a Lathe with Special Die-holder

in position by a bolt *C* which passes through it and engages the toolpost slot of the lathe slide. In using the holder, the carriage is moved forward until block *B* comes in contact with the large end of the die-holder thus starting the die on the rod which is to be threaded. As the work continues to revolve, the die automatically feeds forward. After the thread has been cut to the required length, the spindle is reversed, while the operator holds the handle against the carriage to prevent a reverse rotation of the die-holder.

Campello, Mass. EDWIN HANSALPAKAR

NOTCHED STRIPPER PLATE

There is often a slight delay in starting strip stock in a blanking die caused by the difficulty of entering the end of the strip in the slot cut in the stripper plate. This is most noticeable with thin, wide stock, as, for example, stock 6 inches wide by 1/16 inch thick. The writer has found that this difficulty can be avoided by cutting a notch in the stripper plate at the starting end, as shown in the accompanying illustration. This notch allows the end of the strip stock to be placed on the end of the blanking die and quickly guided to the opening in the stripper plate, so that there is no lost motion. The illustration shows the stripper plate arranged for feeding the stock from right to left. The same principle applies, however, if the stock is fed from left to right, but in that case the left-hand end of the stripper would be notched or cut away.



Stripper Plate with Notch cut in End to facilitate entering Stock

West Hartford, Conn. ERNEST L. HOLCOMB

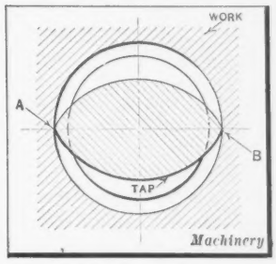
KINK FOR DEEP-HOLE DRILLING

When performing deep-hole drilling operations in a lathe, it is a good scheme to use a drill 1/32 inch smaller than the size of the hole required, and grind it so that it will cut 1/32 inch over-size. If this is done, the drill will not bind in the hole and it can be extracted more easily should it become broken.

Ontario, Cal. CHARLES HOMEWOOD

CUTTING A LEFT-HAND THREAD WITH A RIGHT-HAND TAP

It sometimes happens that a hole is required to be tapped with a left-hand thread, and a left-hand tap is not available for the job. If there is a right-hand tap of the desired size that can be spared, it is a simple matter to grind it so that it can be made to cut either a left- or a right-hand thread, although it will not be possible to produce as accurate a thread as would be obtained with a regular tap. However, the thread is sufficiently accurate for ordinary purposes. The tap used is ground off on two sides so that its cross-sectional form is oval instead of round, that is, the teeth left at each side are sharpened to a point, as shown at *A* and *B* in the illustration. By exerting pressure on this tap and turning it in a right-hand direction, a right-hand thread will be produced, while if it is turned in a left-hand direction, a left-hand thread will be produced.



Right-hand Tap ground to cut a Left-hand Thread

Rochester, N. Y. JAMES H. BEEBEE

DRAFTSMAN'S BOLT AND NUT CHART

A chart made up of diagrams of different sizes of bolts and nuts such as is shown in the accompanying illustration will be found useful by draftsmen and tool designers who have a great many bolts and nuts to lay out. This usually necessitates looking up the various dimensions in a handbook. These dimensions can be taken directly from the chart with a compass or dividers, thus saving time.

The different sizes of bolts and nuts are laid out accurately to scale on tracing cloth, and a blueprint made. The blueprint is then pasted on a piece of cardboard. If more than one form of bolt or cap-screw is used continually, charts might be placed on each side of the cardboard.

The dimensions thus obtained directly from the chart are the distance across flats and the distance across corners for square and "hex" bolts and nuts, and the thickness of the head and the nut. The number of threads per inch and the size of the tap drill are also given. In case washers are used to any extent, views of these might also be included, giving the diameters and thickness.

Lansing, Mich. C. F. POWERS

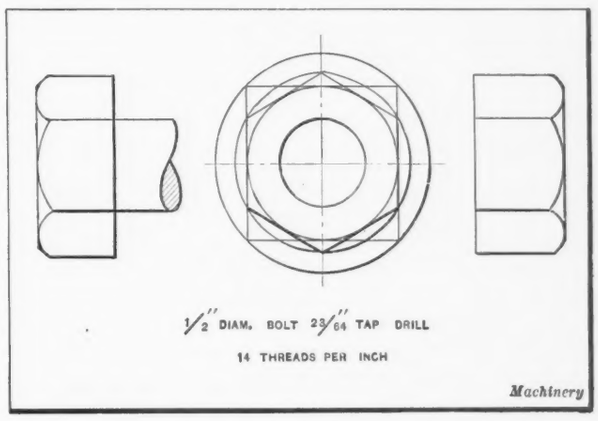


Diagram such as is used in making up Bolt and Nut Chart

Questions and Answers

FORMULA FOR BRIGGS PIPE THREADS

B. A. — Please supply a formula for measuring Briggs standard pipe threads by the three-wire system. MACHINERY'S HANDBOOK and MACHINERY'S Data Sheet No. 17, for September, 1923, give formulas for five different screw thread standards, but do not include the Briggs straight pipe thread.

ANSWERED BY OTTO H. WELKE, WYANDOTTE, MICH.

The formula for measuring Briggs straight pipe threads can be easily derived from the formula used for measuring sharp V-threads by the three-wire system, by simply taking into account the fact that on the Briggs standard pipe thread the top of the thread is flattened to such an extent that the top of the thread is removed from the extreme point of the V-thread to a depth of 0.033 times the pitch.

Hence, if

M = micrometer reading or measurement over the three wires;

D = standard outside diameter of the straight pipe thread;

P = pitch of the thread; and

W = diameter of the wires used;

then the formula for the Briggs straight pipe thread is

$$M = D - 1.732P + 3W + 0.066P$$

ENGLISH SYSTEM AND METRIC HORSEPOWER

R. I.—In a contract relating to royalties to be paid for the use of a patent, the expression "American horsepower" is used. I did not know that there was more than one kind of horsepower, and am puzzled by this expression.

A.—The reason for using the expression "American horsepower" in the contract referred to is doubtless to distinguish it from the metric horsepower, which is slightly different from the horsepower used in the countries employing the English system of measurements. As stated in MACHINERY'S ENCYCLOPEDIA, Vol. IV, page 31, under the heading "Horsepower," this unit of power adopted for engineering work, as defined in the English system of measurement, is equal to 33,000 foot-pounds per minute, or 550 foot-pounds per second. The metric horsepower, used in countries where the metric system is employed, is equal to 75 kilogram-meters per second, which is only 32,550 foot-pounds per minute, or 542.5 foot-pounds per second. Hence, it is evident that the metric horsepower is about 1.5 per cent smaller than the horsepower employed in the countries using the English system of measurements.

WHEN A PATENT APPLICATION IS OPPOSED BY ANOTHER

L. T. N.—I have an application for letters-patent which has been placed in interference with another application filed by a party to whom I displayed and explained my invention. I am the inventor and an attempt is being made to take from me what is rightfully mine. What is the proper course to follow in this matter?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

If when you first conceived your invention you made a drawing of it which you signed and dated, if you explained the invention to others and know the dates of such disclosures, or if your drawing was witnessed, you will in all probability be able to prove your priority of inventorship. If the party claiming the same invention is actually an independent inventor, it will be necessary for him to submit proofs and testimony that will antedate the time set by you. The one who first conceives an invention is not under the law the first inventor, but the one who in addition to conceiving the invention, first reduces it to practice by making a working machine, device, or model, and shows it to others in order to substantiate his dates.

The filing of an application for letters-patent is deemed to be a reduction to practice for the reason that the description and drawing must be so full and complete as to enable those skilled in the art to make and use the invention. The first person to file an application would not be given priority over an opponent who first conceived and made a demonstrable machine or device. Interference proceedings are of a complicated nature, and require experience and skill to a marked degree on the part of a patent attorney for their proper conduct.

U. S. STANDARD SCREW THREAD SYSTEM

I. D.—In the table of U. S. standard screw threads, on page 1002 of MACHINERY'S HANDBOOK, diameters from 1/16 inch up to 6 inches are given, and sixteenth sizes, such as 11/16 and 13/16, are included. I have been told that the U. S. standard system of threads begins with ¼ inch, and that the sixteenth sizes mentioned are not included in the standard system. What is the authority for the table given in MACHINERY'S HANDBOOK?

A.—William Sellers originally proposed the screw thread system that later became known as the U. S. standard system for screw threads. In the original tables of this standard as proposed by Mr. Sellers, the smallest screw was ¼ inch in diameter, and the sixteenth sizes above ⅝ inch were not included. A report was made to the United States Navy in May, 1868, in which the Sellers system was recommended as a standard for the Navy Department, and from that time on the system has been known as the U. S. standard system of screw threads.

It was soon realized, however, that standard numbers of threads were required both for diameters smaller than ¼ inch and for sizes advancing by sixteenths above ⅝ inch. As a result, George M. Bond of Pratt & Whitney Co., Hartford, Conn., prepared an extension of the original table of U. S. standard threads, covering sixteenths, in which the original formula used by Sellers for determining the number of threads per inch was used. Mr. Bond also proposed a formula, in 1882, that would apply to sizes below ¼ inch diameter, and on the basis of which standard numbers of threads for these sizes could be established. All of this work was presented by Mr. Bond before the Franklin Institute, February 29, 1884, and Mr. Bond's paper was reprinted in the Journal of the Franklin Institute, May, 1884.

The table given in MACHINERY'S HANDBOOK is based on the tables presented by Mr. Bond, in 1884, which have since been accepted by the tap and screw makers of the United States as the U. S. standard thread. The only difference in the present standard from the table presented by Mr. Bond is that the number of threads for the 11/16, 13/16, and 15/16 sizes were given by Mr. Bond in accordance with the theoretical number found by the Sellers formula, but common practice, as Mr. Bond mentions, at that time had made eleven, ten and nine threads per inch, respectively, the accepted number of threads for these diameters, and ever since these have been know as U. S. standard threads.

Hence, the table in MACHINERY'S HANDBOOK records, not the original Sellers standard, as accepted by the U. S. Navy in 1868, but an extension of this system as proposed before the Franklin Institute in 1884, with the modifications accepted by the tap and screw manufacturers of the United States and incorporated in the original standard.

AUTOMATIC TEMPERATURE CONTROL FOR INDUSTRIAL FURNACES

By H. M. CANDEE, Engineering Department
The Bristol Co., Waterbury, Conn.

There is a need at the present time for improved methods of heat control as well as for competent operators who can properly employ the improved means, including furnaces, pyrometers, fuel, etc., to obtain the best results. Automatic temperature control does not mean that the human element can or should be entirely eliminated. The control of the furnace temperature may be automatic, but the control of the proper application of the heat to the product requires a skilled craftsman. A large percentage of the work passing through modern heat-treating departments depends upon the skill and judgment of the operators for its successful treatment, irrespective of the fact that automatic devices are used to control the temperature.

Uniform temperature is necessary to produce a uniformly heated product, but uniform heat in the furnace does not necessarily mean uniform heating of the charge within the furnace. Automatic temperature control will insure the former condition and will go a long way toward insuring the latter, but the uniform heating of the charge cannot be insured by temperature control alone; intelligent operators are required.

Types of Furnaces

There are a great many types of industrial furnaces in use at the present time, heated by gas, oil, electricity, coal, and even wood. Heretofore the chief objection to the oil- or gas-fired furnaces has been the lack of dependable automatic control, but this objection is now removed because both types may now be controlled by means of several types of automatic control. Before these devices had been developed, however, difficulty was experienced with fluctuating temperatures in gas- and oil-fired furnaces, and it was in an endeavor to overcome this that the electric furnace was developed, the temperature of which may be controlled quite easily by automatic regulators. In the case of coal and wood fires, automatic damper regulation has been applied, but in spite of this, the human element enters rather too much in their operation for successful control.

Automatic Temperature Control Devices

The mechanical devices necessary to obtain automatic temperature control in gas- and oil-fired furnaces consist of (1) a pyrometer or thermostat actuated by the temperature in the oven or furnace; and (2) an automatic valve or switch controlling the fuel input. There are several types of temperature control instruments, each designed for its own particular purpose. For temperatures not exceeding 800 degrees F., a thermostat or thermometer controller is employed. For higher temperatures—above 800 degrees F. but not exceeding 3000 degrees F.—a pyrometer controller is used.

The control valves that regulate the fuel input may be divided roughly into two classes—the magnet or solenoid type and the motor-driven valves. Some types of magnet valves are operated directly by the pull of the solenoid; in others, the solenoid actuates an air or steam valve, so that the pressure of air or steam is used to actually lift the fuel valve. The solenoid type of valve has been extensively used in the past, and is familiar to most men in the heat-treating field. The motor-driven valve is a more recent development.

In one type of motor-driven valve, both the fuel and air valves are operated by one motor. An automatic controlling instrument is used in connection with these valves to measure the temperature of the furnace. Both the valves are adjusted first to give a flame of perfect combustion which, however, will give too low a temperature to bring the furnace up to the desired heat. Later the valves are adjusted to give a higher temperature flame, bringing the heat of the furnace slightly above the temperature required. Then, as soon as the furnace has reached this higher temperature, the controlling instrument will cause the motor to operate, thereby closing the valve in such a manner that, when a sensitive controlling instrument is used, the furnace can be kept steadily at the required temperature.

The fact that greater power is supplied by a motor than by a solenoid makes this type of valve more reliable in operation as compared with the magnetic type; that is, the operation is more positive and less subject to varying influences. The design also permits of a more rugged construction, eliminating delicate parts and fine adjustments. All these factors combine to make it possible to construct a controlling mechanism capable of long and satisfactory service.

Automatic control can be employed on practically all furnaces and ovens used for hardening, tempering, carburizing, and annealing, both in manufacturing plants and in sheet, rod, wire, and tube mills. Briefly summarized, automatic temperature control, when properly applied, results in better quality and greater uniformity of the product, increased production, decreased cost of furnace repairs, and decreased cost of fuel, due to freedom from waste.

* * *

SOFT COAL STORAGE

In view of the necessity for storing coal for future requirements in order to prevent the shutdown of industrial plants in cases of strikes or transportation difficulties, a few rules that have been laid down by the Factory Insurance Association of Hartford, Conn., with regard to the storage of soft coal, are of importance to manufacturers.

Soft coal should preferably be stored in pockets or bins of concrete or brick. If a roof is provided to keep out rain and snow, it should be of non-combustible construction. The space between the roof and the top of the coal should be properly ventilated to avoid danger of explosion of gases. A cone-shaped and elevated bin in which coal is fed in at the top and removed at the bottom is regarded as the ideal arrangement.

Spontaneous combustion is more to be feared from recently mined coal than from that which has been out of the mine for some time. The following precautions, however, are necessary to avoid the danger of spontaneous combustion in *all* soft coal storage.

1. Coal should not be piled against mill buildings or in such a manner as seriously to expose the buildings. It should never be piled around combustible building supports or close to a frame building.
2. Storing near external sources of heat should be avoided, even though such heat may be moderate.
3. Not more than 500 tons should be placed in a pile, and 25 feet of clear space should be kept between piles.
4. Piles should not be more than 10 or 12 feet deep, and no part of the pile more than 10 feet to an air-cooled surface.
5. Alternate wetting and drying should be avoided, and if coal is received wet, it should be placed around the edges of the pile where air can get to it freely and where other coal will not be piled over it.
6. Lump and fine coal should be mingled as much as possible to avoid lumps forming air passages which facilitate the spread of fire.
7. Air should not be admitted to the interior of the pile through interstices around piers, timbers, etc.
8. Pipes about 1 inch in diameter should be located vertically in piles, one to each 300 to 400 square feet of area (three or four pipes ordinarily will be satisfactory for a 500-ton pile). The lower ends of these pipes should be at varying distances from the bottom of the pile. A thermometer should be lowered into these pipes at weekly intervals to ascertain the temperatures existing inside the pile. Pipes should be capped and plugged when not in use in order to prevent admission of air to the bottom of the pile.

The Machine-building Industries

THERE has been no appreciable change in conditions in the machine tool field since last month. Business in new equipment is holding up at about the same rate as during the closing months of 1923. The general business outlook for the first part of this year is good, but as yet there is no great increase in industrial activity in sight; hence there is no likelihood of any large immediate increase in machine tool demand. On the other hand, there are no signs of reduced activity in any field, and the demand for new shop equipment is likely to remain steady at present levels for the winter months, with the usual seasonal increase in the spring.

In one branch of the machine tool field, the demand is very good—this is for high-production automatic machines. One of the larger builders of machines of this type is fully occupied, and several others are working nearly to capacity, with orders ahead for several months. In the standard machine tool field, lathes and drilling machines are in fair demand; shapers and milling machines lag somewhat behind at present. The shops of most of the well-known machine tool builders average from 40 to 60 per cent of capacity.

The demand for steam and drop hammers has been good, with practically all orders coming from the automotive field. Cold-heading machines and bolt and nut machinery in general are said by some builders to be in active demand, one plant in this field, at least, working to capacity. The demand for swaging machines is also good.

Small Tools and Accessories

The brisk demand for small tools early in 1923 has somewhat abated. The demand at that time exceeded the capacity of some of the plants, especially in the drill field, and stocks were depleted. At present these stocks are being replenished, and a more active demand is soon expected, because users have been buying largely from hand to mouth and have no stocks on hand. Of the different classes of small tools, the demand is better at present for taps and dies than for other lines; but the cutter, reamer, and drill business is improving after the seasonal falling off during the last two months. Sales of die-heads and chasers are exceptionally good; and in the accessories field, including drill chucks, lathe chucks, and vises, the reports vary from "fair" to "very good." Practically all the manufacturers of lathe chucks reduced their stocks during the past year and several state that at present their sales exceed their production, the shops running at about 50 per cent capacity.

As might be expected, in every field where the automotive industry enters as a buyer, business continues good. This applies to balls and ball bearings, roller bearings, chain, and drop-forgings. There has been a slight seasonal falling off in these lines, but no important reduction in activity.

The Iron and Steel Industry

The iron and steel industry—the barometer for the entire metal-working field—is the source of the most encouraging news at the present writing. The December unfinished orders of the United States Steel Corporation showed an increase for the first time since last March. A decline had been expected and therefore a gain of over 76,000 tons was rather a surprise. Any further increase in the steel business will probably result in an upward trend in both pig iron and steel prices—more particularly in pig iron.

The steel industry operates as a whole at about 70 per cent capacity, with the Steel Corporation's plants above the average, at about 82 to 84 per cent. Inventories in the steel plants are low, which is also an encouraging factor. The pig iron production in December was about 14 per cent above the average 1913 production, but during the entire year of 1923, 50 per cent more pig iron was produced than in 1913. The same is true of steel ingots, the output of which in 1923 exceeded all previous records, including the war period.

In 1923, the railroads took about 30 per cent of the total production of the iron and steel industry. Fifteen per cent went for structural purposes; the oil industry required 11 per cent; the automobile industry, 10 per cent; and the machine-building field, 3 per cent. Between 6 and 7 per cent of the total production was exported.

The general situation in the iron and steel field is satisfactory. There is every indication of continued steady building activity and railroad prosperity. The automobile industry will probably continue to take its share of steel production.

The Automobile Industry

Complete figures are now available covering automobile production in 1923. The total output of passenger cars and trucks was 4,005,230; this is an increase of 56 per cent over 1922. Ford production is reported as 2,199,500, including Ford cars, trucks, tractors, and Lincoln cars. The General Motors Corporation sold 796,000 cars during the past year. Five companies now make 80 per cent of all the automobiles built in the United States. The average wholesale price of passenger cars in 1923 was $610, as compared with $955 in 1920.

While automobile production for the moment has dropped slightly, due to seasonal fluctuations, manufacturers are uniformly optimistic, expecting practically the same production in 1924 as for 1923; a production of at least 3,500,000 cars and trucks is confidently expected. Consolidations of many of the smaller and weaker companies are likely to take place. While many of the smaller concerns were kept busy in 1923, their financial showing is not satisfactory. It is rumored that both Ford and the General Motors Corporation are planning extensive increases in some of their plants, and that large sums will be spent for new buildings and equipment.

Business Prospects for the Coming Year

Secretary Hoover, in summarizing his opinions of the business prospects for 1924, states that the economic outlook for the next year is bright; the general spirit of prudence, the absence of speculation, complete employment, high production, and the great financial strength and stability of the United States creates a hopeful foundation on which business may build for the coming year. The Federal Reserve Bank points out that the new year starts with much in its favor, and that one of the biggest single factors beneath present stable business conditions is the conservatism among those charged with the responsibility of carrying on business, a conservatism neither unduly influenced by unfounded expectations nor pessimistic opinions of the future. Other important factors pointing toward continued business activity are the effective demand of a people generally well employed; efficient transportation; an improved agricultural situation; great activity in building; efforts to economize in production and selling; individual tendency to save, and increasing faith in business stability. These facts form a foundation upon which it is perfectly safe to build with conservative judgment and a progressive attitude toward the future.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

National-Acme Five-spindle Automatic

AMONG the latest developments in machinery designed with a view to the attainment of increased production and higher accuracy is a model C five-spindle automatic screw machine that has just been placed on the market by the National Acme Co., Cleveland, Ohio. Those familiar with the Acme and Gridley machines built by this company will instantly realize that the five-spindle machine represents an innovation in design. The provision of five spindles instead of four, permits the distribution of cutting strains over a larger number of tools, and as a result, there is less tendency for strain to occur at points where heavy cuts are being taken. Consequently, operations can be performed at higher rates of production and yet a high degree of accuracy is maintained in the product.

This machine has a capacity for 9/16-inch round, 25/64-inch square, and 31/64-inch hexagonal stock; a maximum length of feed of 5 inches; and a maximum regular turning length of 4½ inches. The normal production ranges from 300 to 3000 parts per hour. In designing this machine, a number of the features incorporated in the Acme and Gridley machines were adopted, but there are also many new features, among which may be mentioned the exclusive use of right-hand tools, telescoping main tool-carrier, improved type of spindle-carrier, indexing mechanism for the spindle-carrier, forming and cutting off slide guides, stock feed in either the first or fifth spindle, or both (with no interference to operating tools in feeding positions), draw-in collets, absence of any moving drums or gears under the tools, and centralized lubrication.

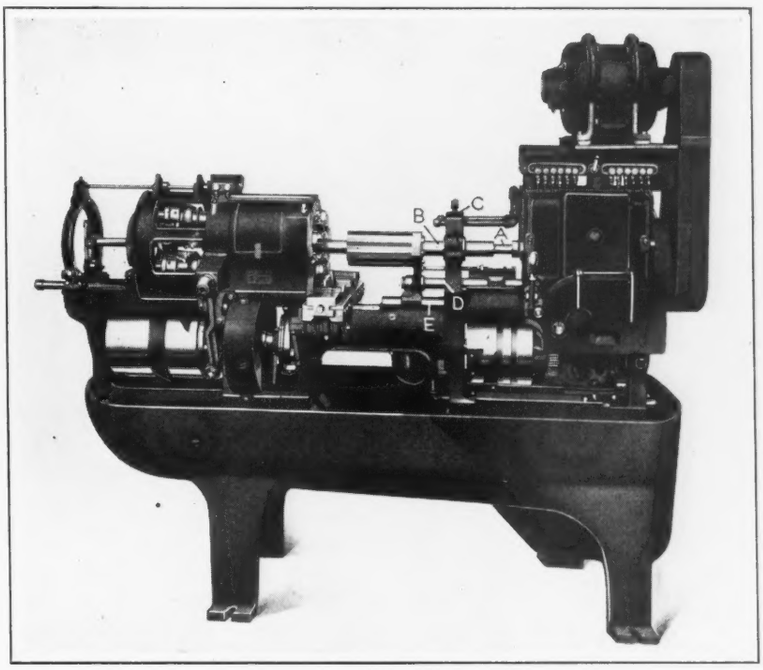


Fig. 1. National-Acme Five-spindle Automatic Screw Machine

General Features of Design

From Fig. 1, which shows a front view of the machine, it will be apparent that one of the outstanding features is the construction of the tool-slides, which has been so worked out that there is no obstruction to prevent ready access to any tool. Another feature is that all cams and other mechanisms have been arranged in two groups at the ends of the machine, leaving a clear space at the center into which the chips can drop without damaging the machine parts. In so far as the general arrangement is concerned, this machine conforms in design to preceding types. There is a main driving shaft running through the machine, with a camshaft below on which are mounted cams for controlling the various mechanical functions to be performed simultaneously or in sequence.

The machine frame consists of two chief members—a bed and pan casting with nine finished pedestals on which are supported the frame that contains the various mechanisms. This frame construction is said to afford maximum rigidity and positive alignment between the important operating members, the positions of which must be accurately maintained in relation to each other. A spindle-carrying head mounted on one end of the machine contains the work-spindles, and this head is indexed, step by step, to bring the spindles into five positions for the progressive cutting operations. The tools are mounted on a main tool end slide and on cross-slides to complete the work in the time required for the longest operation or fraction thereof.

Power for driving may be furnished by an individual electric motor directly connected through a silent chain, or by a single pulley belt drive. The top shaft *A*, which drives the spindles, runs through the machine, power being transmitted from the shaft to the spindles by means of hardened steel spiral gears.

Attainment of accuracy in automatic screw machine products requires the maintenance of close alignment between the work-spindles and the tool-slides. This is assured in this machine by mounting the tool turret on a sleeve *B*, which surrounds shaft *A*. The sleeve extends forward from the turret and is piloted into the spindle-carrying cylinder. There is also a rear support in the frame upright extension *C*, which is cast integral with the frame. A further support that insures resistance to side thrusts has been provided by extending the slide pusher rod *D*, Figs. 1 and 3, independently of the carrier and attaching it to a support that travels along the hardened and ground steel plate *E*, which is attached to the saddle of the frame. This construction not only assures initial alignment, but should it happen that after a long period of service, appreciable wear causes a sagging of the spindle-carrier, the tool-carrier will be correspondingly depressed due to the telescoping support. Hence, alignment of these two members is always maintained. The method of carrying the tools also makes it possible to set up the tool-holders on the turret and bore them with tools mounted in the work-spindles, thus providing the initial accuracy of alignment.

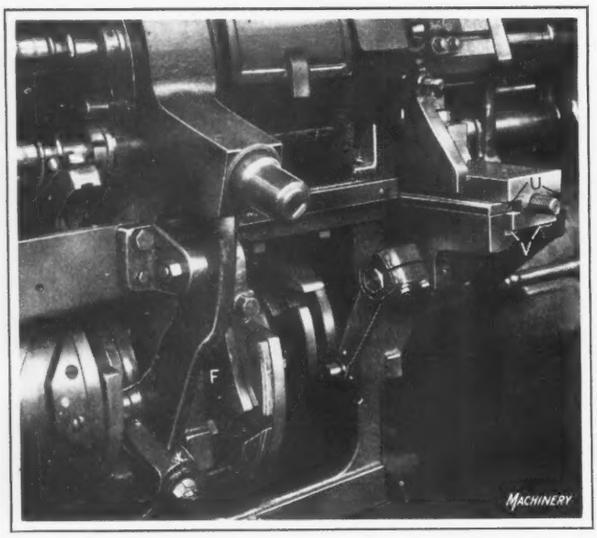


Fig. 2. Partial View of Geneva Movement employed for indexing the Spindle-carrying Cylinder

In order to reduce torque as much as possible, the spiral gear drive to the spindles is located in the center of the spindle-carrier instead of at the rear end, as was the case in earlier types of Acme automatics. Spiral gears are used with a view to obtaining a drive having a smooth action with a high degree of uniformity in the transmission of power. By locating the drive at the center, it was possible to lengthen the cylinder so that its bearings at each end could be liberally proportioned and yet be placed at a sufficient distance from each other to insure accurate alignment of the cylinder. The total length of the bearing surface is equal to one-half the length of the cylinder. At the top of the housing there is a shoe which can be adjusted downward to compensate for wear developing between the cylinder and the housing.

The housing is counterbored at the front, and the cylinder is set in this counterbore for its entire periphery, the purpose of this construction being to afford resistance to end thrusts. Take-up for end wear is accomplished at the rear of the housing by means of three shoes. The spindles proper do not become worn, because they are fitted with bronze bearings running in steel bushings which are hardened, ground, lapped, and fitted into the spindle-carrier.

Indexing Mechanism for the Spindle-carrier

When it is recalled that the production of parts on this machine ranges from 300 to 3000 pieces per hour, it will be evident that the highest rate involves the necessity of revolving the cylinder fifty times a minute, or almost once every second. This rapid indexing is accomplished by a special application of the Geneva movement, which is partially shown in Fig. 2. The mechanism consists of a cam *F* that rotates in contact with three rollers mounted on a spur gear which meshes with teeth cut in the under side of the spindle-carrying cylinder. The Geneva movement is such that the indexing of the cylinder consists of a gradually accelerated movement followed by a correspondingly decelerated movement. In this way, inertia is gradually overcome at the beginning of the indexing, and the momentum is correspondingly slowed down at the end, with the result that there is no serious amount of shock at either the beginning or the end.

Locking of the cylinder is accomplished through a combination of latch- and lock-bolts. Cut around the cylinder are five teeth similar to those of a ratchet wheel, each having a straight face and an inclined surface. As the spindle-carrying cylinder indexes, the latch-bolt rides up the inclined face against the tension of a spring, and when the cylinder has reached its next spindle position, the latch-bolt snaps into place. At this point a cam becomes effective and pushes the tapered lock-bolt into a correspondingly tapered pocket in the opposite side of the cylinder. The taper of the bolt causes a slight further movement of the cylinder, bringing the flat face of the ratchet tooth into contact with a corresponding face of the latch-bolt. By this means there is a combined action of the latch- and lock-bolts which holds the cylinder, and both bolts tend to pull it and the housing down toward the bed of the machine. Such being the case, there is a rigid support and no tendency to push the work-spindles out of alignment with the tools.

Work-holding Arrangement

Preceding types of Acme screw machines were furnished with push chucks which were closed by advancing the chucks into a taper-bored cap fitting over the spindle noses. This construction necessitated a considerable overhang of the spindles, and to avoid this, draw-in collets have been substituted for the push chucks on the new five-spindle machine. The result has been that the spindle noses have been brought in close to the front end of the carrier.

In Fig. 4, a rear view of the spindle mechanism illustrates the provision made for opening and closing the collets. This is accomplished by means of shoe *G*, which actuates a taper spool on each spindle. When the spool is moved forward to release the collet of a spindle, fingers *H* are released from the tapered surface and thus loosen a clamp which normally holds the stock-feeding tube *I* in a stationary position. Trouble has sometimes been experienced in designs operating at high speeds from fingers *H* flying outward, due to centrifugal force and causing breakage of parts. In a machine of the present type, this trouble would ordinarily be more likely to occur, but to prevent this a special arrangement of springs has been provided to restrain fingers *H* from outward movement.

When the collet spool has been pushed forward, as shown at *G*, the stock-feeding tube has been released so that it may be moved forward to advance the stock against a stop into the operating position. This forward movement is accomplished by means of a coil spring *J*, which pushes forward member *K*, on which is mounted a dog *L*, contacting with the rear end of the stock-feeding tube. Feeding of the stock may be accomplished at either the first or fifth position, but dog *L* must be moved to the opposite side of member *K* when feeding at the first position instead of at the fifth as shown. In some cases where exceptionally long work is being handled, it may be advisable to feed in both the first and fifth positions by using two dogs *L*.

After spring *J* and dog *L* have pushed the stock feed tube forward to bring the stock into contact with the stop, shoe *G* closes the collet. Then a cam on the drum located beneath member *K* pushes this member back against the tension of spring *J*, and in so doing, ring *M* pulls back the stock-feeding tube to the initial position. Ring *M* encompasses

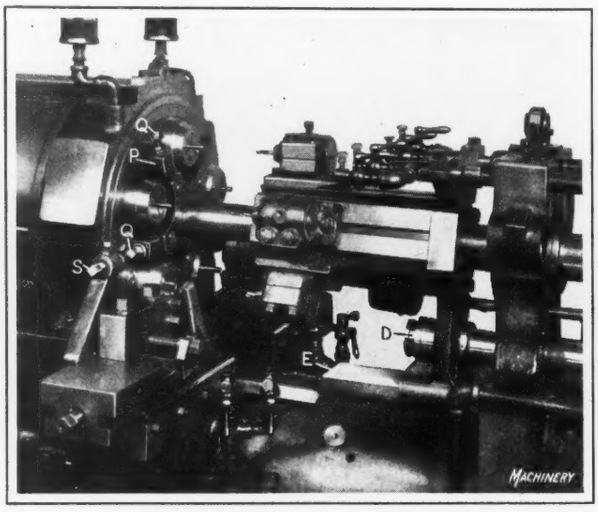


Fig. 3. Close-up View of the Tool-slides, Front Ends of Spindles, and Stop-spider

all five stock-feeding tubes and returns them into positive positions against plate *O*. Upon its return, the head of each stock-feeding tube enters a pocket in disk *N*, this construction preventing the tube from vibrating while indexing is in process. As disk *N* indexes with the spindle-carrying cylinder, it is always in alignment ready to receive the head of the feed-tubes. It will be seen that there are two elongated holes in plate *O*. To remove the feed-tubes, plate *O* is simply turned against a spring tension to bring the notches into line with the pockets in disk *N*, after which the tubes may be conveniently withdrawn. When released, plate *O* snaps back automatically into the position illustrated.

At the left-hand end of the bed in Fig. 4, will be seen a stock reel bracket bolted direct to the bed. This construction provides a rigid support for the reel and tends to minimize the tendency for the stock to vibrate during cutting, at the same time, assisting stock alignment as the spindle-carrying cylinder is indexed from position to position. The stock reel is connected to the shaft *T*, which supports disk *N* and plate *O;* the reel extends between the spindles and is also fastened to the spindle-carrier. Consequently, when the carrier is indexed, the reel is turned by the shaft, the result being that the reel tubes are not strained and are always in alignment with the spindles. Such other stock reels as may be required are carried on the usual form of pedestal brackets. A hand chucking device is provided for loading stock and for removing stock butt ends. This operates in the third spindle position.

Design of the Cross-slides

A point of interest in connection with the five-spindle automatic is the "double-deck" cross-slide construction. Instead of mounting the cross-slides on bearings planed on the bed of the machine, upper and lower hardened steel bearing plates *U* and *V*, Fig. 2, are provided for each slide. This design affords maximum durability with no wear whatever of the bed proper.

Fig. 3 shows the means provided for stopping the cross-slides accurately at each spindle position. Spider *P*, secured at the front end of the spindle-carrying cylinder, has a leg projecting outward between each spindle and carrying a set-screw *Q* at the end. Secured to the cross-slides is a bracket on which a hardened screw *S* is mounted, which comes in contact with one of screws *Q* each time the cross-slide feeds forward, and thus fixes the position at which the cross-feed stops. This device is important, because in the event of, say, 0.001 inch difference in the location of the spindles relative to the center of the carrying cylinder, the resulting inaccuracy in dimensions of the product will be twice that amount. But by adjusting screw *Q* for each

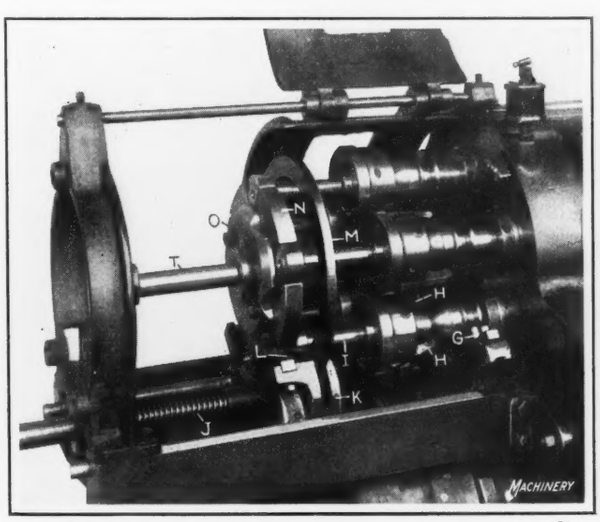


Fig. 4. Mechanism at Rear End of Spindle Housing for opening and closing the Draw-in Collets

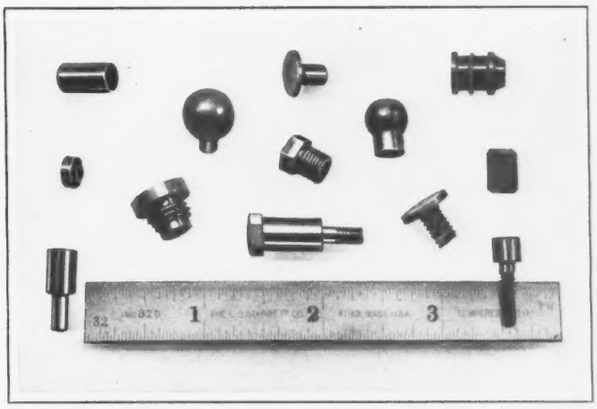


Fig. 5. Work produced on the Five-spindle Automatic at from Forty-five to Sixty Pieces per Minute

spindle, the settings can be closely made and accuracy obtained.

The machine is equipped with a gravity-feed oiling system whereby the delivery of lubricant to each bearing is regulated by means of an individual valve. In addition, there is a single control lever by means of which supply pipes can be opened or closed at will. Fig. 5 shows a group of typical pieces of work produced on the new automatic at rates ranging from forty-five to sixty pieces per minute.

BUDD-RANNEY HEAVY-DUTY AUTOMATIC

A new type of automatic bar machine designed for producing at high rates the simpler classes of screw machine products, especially parts requiring longitudinal drilling, such as nut blanks, bushings, chain rollers, and pipe couplings, has recently been placed on the market by the Budd-Ranney Engineering Co., 44 E. Chestnut St., Columbus, Ohio. The machine is arranged to cut off, form-turn, drill, counterbore, and box-turn such articles as can be finished in a single cut. It is perhaps best adapted for making nut blanks from hexagonal bars.

The machine is built in four sizes—the No. 1 having a maximum capacity for 1-inch round or ⅞-inch hexagonal stock and producing pieces up to 1 inch in length; the No. 2 having a maximum capacity for 1½-inch round or 1¼-inch hexagonal stock and producing pieces up to 1¼ inches in length; the No. 3 having a maximum capacity for 2½-inch round or 2 3/16-inch hexagonal stock and producing pieces up to 1¾ inches in length; and the No. 4 having a maximum capacity for 4-inch round or 3⅛-inch hexagonal stock and producing pieces up to 2¼ inches in length. The Nos. 1, 2, and 3 machines are of the double-spindle horizontal type illustrated in Figs. 1 and 2, while the No. 4 machine is built with a single spindle only. All styles are motor-driven, a silent chain transmission being employed between the motor and the clutch shaft. A silent chain is also used to drive the drill spindle from the clutch shaft, while a gear transmission is employed between the clutch shaft and the stock spindle.

Coolant is furnished by a centrifugal pump driven by a direct-connected independent motor. On the double-spindle machines this pump supplies the cutting compound at a 10-pound pressure, while on the No. 4 machine the pressure is 20 pounds. The independent pump drive is provided so that a constant coolant pressure may be maintained regardless of the speed at which the machine is operated, which, of course, is changed for the different types of material handled. Each machine is equipped with a variable-speed motor-driven fan, which supplies an air draft through the cutting chamber to keep the temperature from becoming excessively high, thus avoiding the generation of steam and making continuous operation possible. A water- and vapor-proof electric lamp is mounted in the cutting chamber, and is so located that the cutting can be observed through the

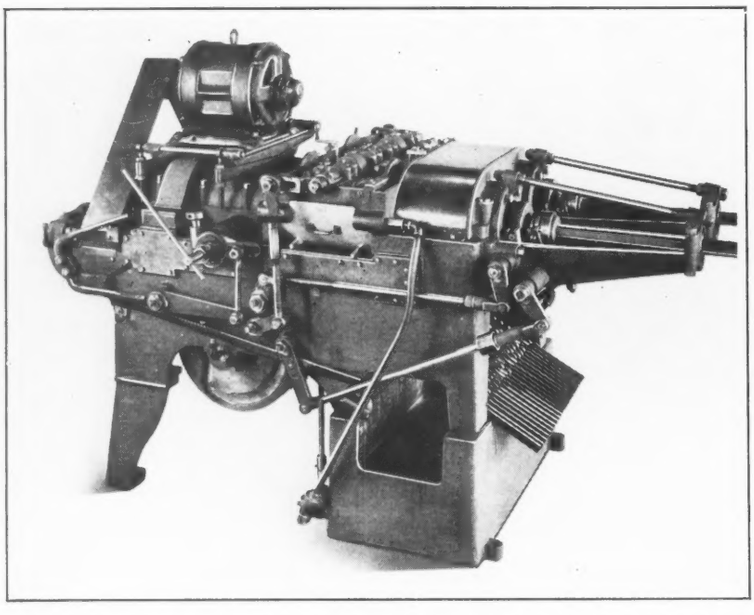


Fig. 1. Budd-Ranney Double-spindle Heavy-duty Automatic Bar Machine designed for producing the Simpler Screw Machine Parts

film and splash of the coolant without shutting off the supply.

Details of Construction

The work and drill spindles and all other important high-speed revolving parts are mounted in ball bearings, and the motor is similarly equipped, while all cam rollers are mounted on roller bearings. The stock guides run in ball bearings, and the stock is carried on rollers which reduce the feeding friction to such an extent that the machine can handle bars of any desired length. With a view to providing a chuck that will more readily accommodate stock of varying sizes, the centrifugal principle for securing a gripping power has been adopted and cams are employed for releasing purposes. In this machine, drilling and cutting off are performed simultaneously, and so the chucking must be firm. This is provided for by having sufficient mass in the revolving weights and a releasing mechanism of ample strength. The nearer the weights are forced toward the spindle, the lighter the cam effort required, and consequently a rapid cam movement is permissible when the chuck has once been partially opened. A feature of the centrifugal chuck is that it is always released when the machine is not running.

A longitudinal section through the stock spindle and chuck weight chamber is shown in Fig. 3, which also shows the feeding tube. There is a spline drive between the chuck collet and the feeding tube, which holds the stock central with the chuck opening when the chuck is released and prevents friction from impairing the accuracy of the feed. The length of feed is governed solely by the feed stroke. Another feature is the inner tube used to expand the feed fingers for withdrawing or entering stock, or for neutralizing the feed, which may be desirable when setting up the tooling to accommodate a different product. The springs contained in pockets of the bearing retaining nut prevent the spindle from floating during the cutting cycle, regardless of the bearing adjustment, and permit an adjustment free enough so that expansion and contraction due to changes in temperature will have no detrimental effect on the bearings.

In making nut blanks, a combination drill guide and counterbore is mounted in a box turning head. This mechanism advances for the counterboring, tarries, centers the drill, and then backs rapidly away to permit the drill chips to escape. After the blank is drilled and the drill backs away, this turning head advances and strips the blank from the drill, in case it has failed to fall.

The cams are so constructed that the tools cut during 310 degrees of the cam movement, or 86 per cent of the cycle. The cams are of the disk type, the one for opening the chuck being a plain open style, and the one for the cutting movements being profiled. No springs or weights are used to effect the return movements. The cams are located under the drill spindle. Hardened rollers equipped with roller bearings transmit motion from the cams through levers and links to the desired points.

Setting up the Cut-off and Forming Tools

The arrangement of the cut-off and forming tools on the double-spindle machines is shown in Fig. 4, while Fig. 5 shows the arrangement of the tools on the single-spindle machine. In both cases the tools are mounted on platens which may be swung to convenient positions, as shown in Fig. 2, to facilitate tool inspection and replacement. Attention is called to the manner in which the cutting compound is supplied independently to each tool and directed on the work from behind the cutter blades. Thus the force of the compound helps rather than hinders the escape of the chips from the cutting edges, and chips cannot get into a position where they will obstruct the stream of coolant. Two tools are used in the single-spindle machine for the cut-off, one of these being a 120-degree diamond-point tool, which is supplemented by a tool of more regular form which is a few thousandths inch wider. This tool takes a shaving cut and furnishes a clearance for the diamond-point tool. The latter is sharpened by grinding on the end only, which results in a low tool cost.

After these tools have performed their function, the stock is fed forward and the drill and counterbore do their work while the cut-off tools are operating on the next piece. Attention is called particularly to the fact that the article is drilled off and not cut off. In place of drilling in and cutting off, the work is cut in and drilled off. This arrangement keeps the tools further apart so that the heat generated by one group does not influence the other, and it makes a faster machine cycle possible, because either tool can overlap the cycle of the other. A forming tool, such as is used for chamfering, castellating, etc., may be mounted beside the finishing cut-off blade. The position of these tools is positively located, so that the operator has no measurements to make in setting up a machine. There are graduations for the arm positions and strokes, so that the cor-

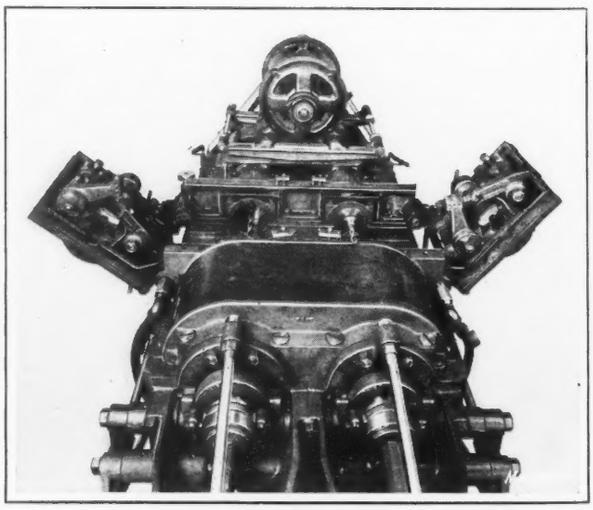


Fig. 2. Looking toward the Drill Spindles with the Tool Platens in the Raised Positions

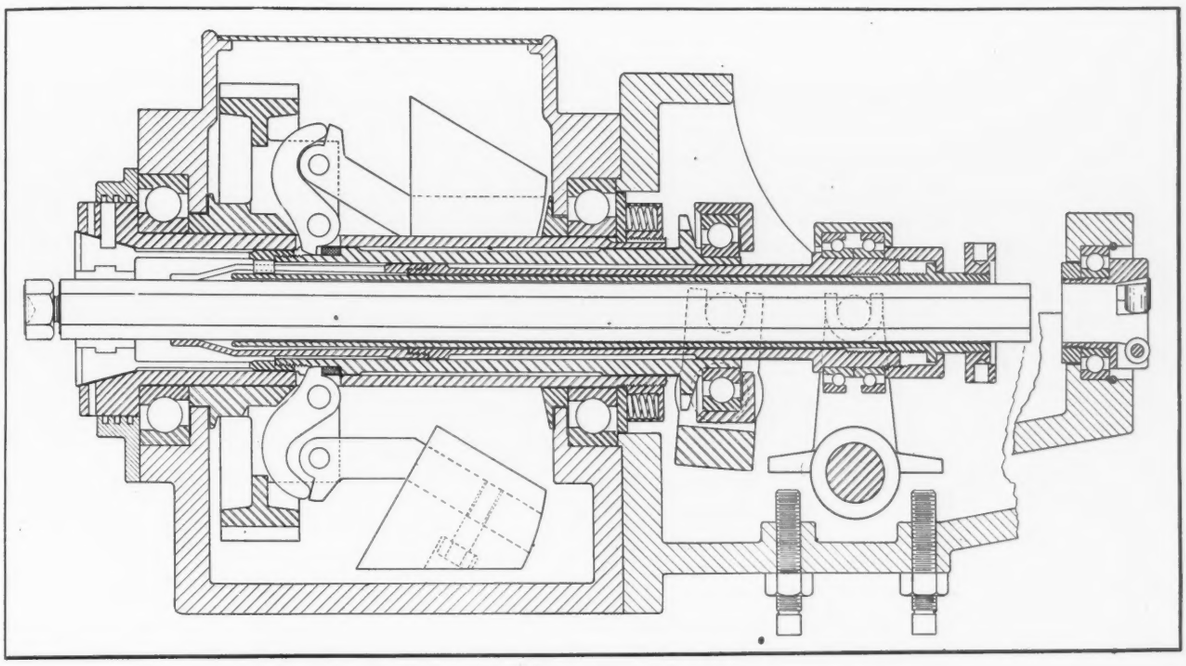


Fig. 3. Longitudinal Section through the Stock Spindle and the Chuck Weight Chamber

rect tools can be placed in position and adjusted with precision according to tables. Any further adjustments for refinement can conveniently be made while the machine is in operation.

On the larger sized nuts the material wasted in chips becomes an important item, especially if the width of the cut is kept in proportion to the depth. There seems to be a limit to the amount of feed a certain width of tool will carry, and for this reason two diamond-point tools and one finishing tool are provided on the No. 4 machine, as shown in Fig. 5.

In the Nos. 1, 2, and 3 machines, the two spindles can be run independently, with either or both sides operating. In the Nos. 1 and 2 machines, the spindles can be run at different speeds and feeds and on different sizes and types of product, while on the No. 3 machine the spindles can also be run on different sizes and types of product and at different feeds, but not at different speeds without a special arrangement. The product and chips fall on a grating of inclined bars, between which the product cannot pass. These bars are alternately raised and lowered to cause the chips to drop through and the product to move forward toward a receptacle that is provided to receive it.

The recommended speed at which to run these machines on commercial screw stock is 140 feet per minute for the cut-off, turning, and forming tools, and from 120 feet per minute for small sized drills up to 140 feet per minute for $\frac{5}{8}$-inch drills and larger. The manufacturers also state that for the particular type of tooling employed, feeds of from 0.008 to 0.012 inch are more desirable, from the standpoint of tool maintenance, than lighter feeds, and that, owing to the shaving action of the finishing tools, the amount of feed has no influence on the finish of the product.

If the machines are run at the recommended speeds and feeds, it is said that the tools may be expected to cut about 55,000 feet before grinding is necessary. Thus, in making nut blanks, the tools should last for 36,000 quarter-inch blanks produced at the rate of 2400 per hour; 17,000 half-inch nuts produced at the rate of 1350 per hour; 5600 one-inch nuts produced at the rate of 600 per hour; and 3800 one and one-quarter-inch blanks produced at the rate of 450 per hour, on double-spindle machines, using the two sets of tools. The makers claim to have had an exceptional set of tools which stood up for twenty-seven hours on the one and one-quarter-inch sized nut, using a 0.0088-inch feed and making cuts aggregating about 165,000 feet.

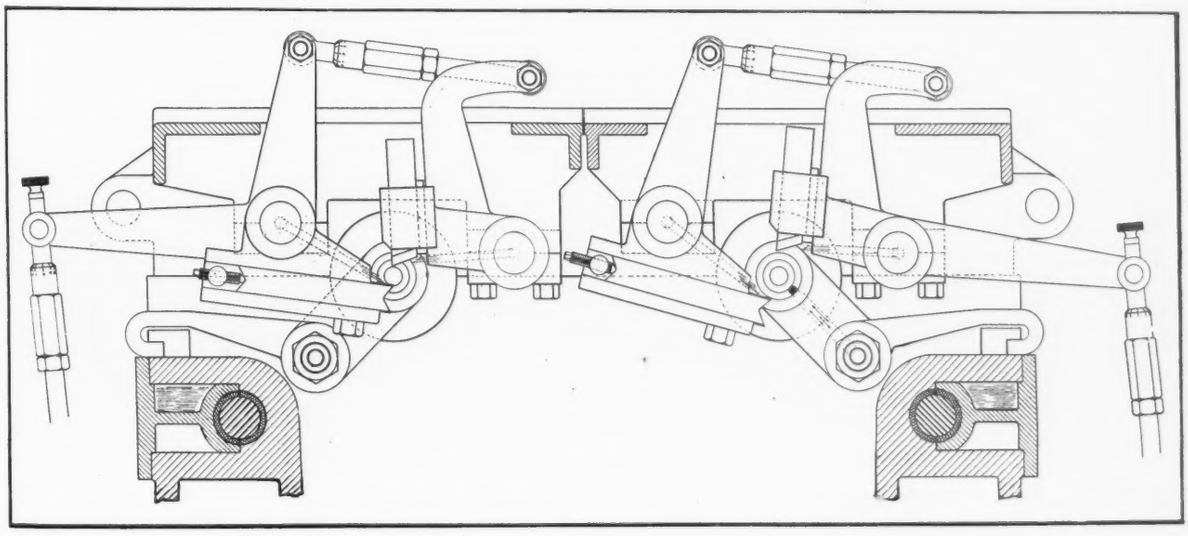


Fig. 4. Arrangement of the Cut-off and Forming Tools on the Double-spindle Machines

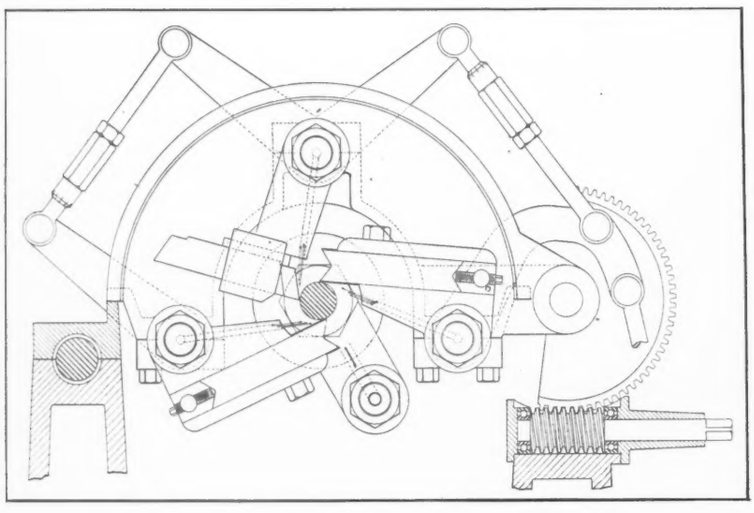


Fig. 5. Arrangement of the Two Diamond-point Tools and the Finishing Tool on the Single-spindle Machine

On the single-spindle machine used for larger sized nuts the tools can be expected to stand up for 1200 one and one-half-inch nuts produced at the rate of 150 per hour; 950 one and three-quarter-inch nuts produced at the rate of 120 per hour; and 750 two-inch nuts produced at the rate of 90 per hour. Because of the different type of tooling used on this machine, a comparison with the smaller sizes is misleading. The No. 1 machine weighs about 4500 pounds; the No. 2 machine, 6300 pounds; the No. 3 machine, 8000 pounds; and the No. 4 machine, 7500 pounds.

LANDIS PIPE THREADING AND CUTTING MACHINE

A pipe threading and cutting machine which handles from 10- to 20-inch pipe with one die-head and one set of chasers is now being built by the Landis Machine Co., Inc., Waynesboro, Pa. This machine is very similar to the 18-inch size described in August, 1923, MACHINERY, and the over-all dimensions and weight are the same. The machine is regularly equipped with a single-pulley drive, from which eight speeds are obtained by means of a speed-box located beneath the main spindle. When driven by a motor, a chain sprocket is substituted for the pulley.

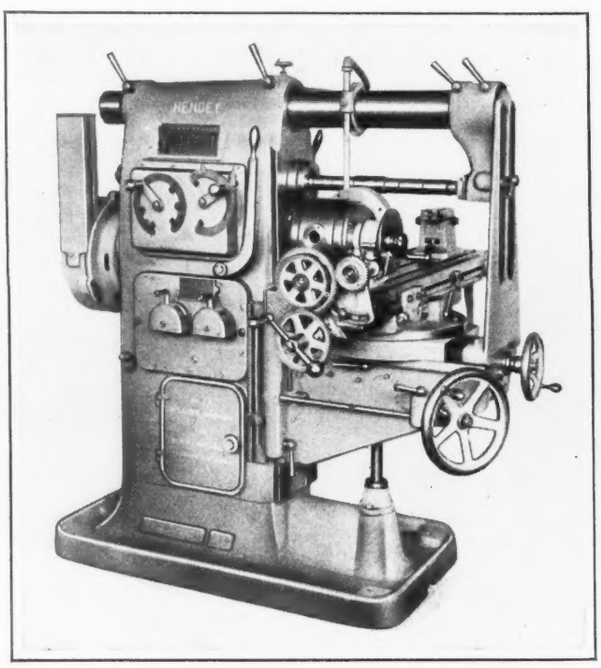
At each end of the hollow spindle there is a three-jaw independent chuck for holding the pipe, the rear chuck being equipped with grips to hold flanges. The carriage that supports the die-head, cut-off tool, and reaming tool is moved either by power or by hand. The power traverse in both forward and backward directions is controlled by a lever located on the operating side of the carriage. Automatic stops prevent the die-head from coming in contact with the chuck on the forward movement and the carriage from running off the guides on the backward movement.

HENDEY GEARED-DRIVE MILLING MACHINE

The No. 2 G geared-drive universal milling machine recently brought out by the Hendey Machine Co., Torrington, Conn., is shown in the accompanying illustration. On this machine eighteen progressive spindle speeds ranging from 15 to 355 revolutions per minute are obtainable through combinations of sliding gears, all shifts being made by means of only two levers which are mounted on a box on the side of the column with the index-plate close at hand. The final drive for all speeds is through a gear keyed fast to the spindle. All driving gears are made of alloy steel and heat-treated. The driving shafts are mounted in ball bearings, as is also the driving pulley. The spindle reverse is obtained by gearing controlled by a lever on the right-hand side of the machine. A change in the direction of spindle rotation does not affect the direction of feeds. The driving pulley is equipped with a friction clutch which is engaged by means of vertical levers located on each side of the machine to suit the convenience of the operator.

The main spindle has taper journals which run in annular bearings, the thrust being taken on the front bearing. The journals have independent adjustments in either bearing. Face mills are centered on the spindle by means of a recess in the mills which fits the spindle nose. They are retained on the spindle by four screws, and are driven by a hardened key. Arbors have a coupling drive which engages with a slot in the spindle nose. An oil reservoir, cast in the mid-section of the column, constantly supplies lubricant to the spindle speed gearing and to all bearings. The oil is elevated by a centrifugal pump to a trough located above the spindle gear, from which it is distributed through a series of pipes to all bearings and gearing in the speed-change mechanism. Overflow holes lead from the spindle-bearing reservoir to keep the oil supply there at a constant level. Continuous lubrication of the spindle bearings is assured by ring-oilers. Cutting coolant is pumped from a large reservoir in the base by a second centrifugal pump. Both pumps are submerged and do not require priming.

The feed-change gearing and its control are carried in a single box casting, applied as a unit to one side of the column. Sixteen feed changes ranging from 0.4 to 20 inches per minute are obtained through sliding clutches operated by two levers, all clutches and gears being made of hardened alloy steel and the shafts being mounted in ball bearings. The feed reverse mechanism is fully enclosed in a box attached to the right-hand side of the knee, which also serves as a reservoir so that the mechanism runs in an oil bath. On the vertical- and cross-feed handwheels, clutches are concealed in the hubs to allow the wheels to run free on the shaft when not employed. The over-arm is of a key type, provided with a locating stop which registers the



Hendey Geared-drive Universal Milling Machine

pendant with the center line of the spindle. The table is fitted to the saddle with a taper gib to take up wear. There is an automatic feed for the table in each direction, and a power quick traverse in each direction can also be furnished.

A few of the principal specifications of this machine are as follows: Distance from center of spindle to overhanging arm, 6¾ inches; distance from face of column to braces, 28 inches; working surface of table, 48 by 12 inches; automatic longitudinal feed, 28 inches; automatic transverse travel, 10 inches; automatic vertical travel below center, 18 inches; swing of index-centers, 12 inches; distance between centers, 26 inches; and approximate weight of machine, 4500 pounds. The machine is also built in a cone-head type which weighs about 3500 pounds. On this machine there are sixteen spindle speeds and eighteen feeds.

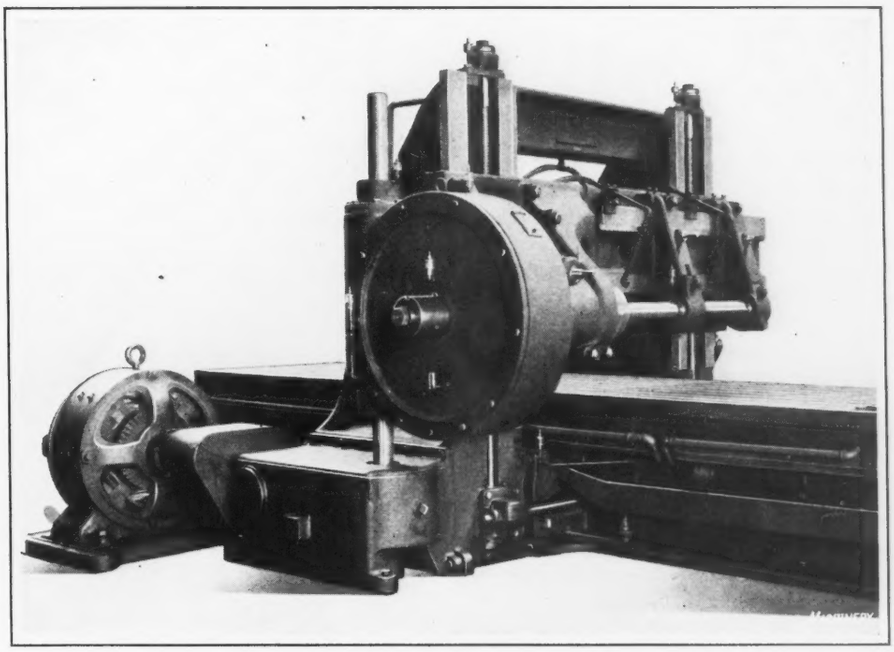


Fig. 2. Rear View of Locomotive Rod Milling Machine, showing the Spindle Drive

BEMENT LOCOMOTIVE ROD MILLING MACHINE

An addition recently made to the line of heavy-duty locomotive rod milling machines built by the Niles-Bement-Pond Co., 111 Broadway, New York City, at the Bement Works, Philadelphia, Pa., is here illustrated. The distance between the housings of this machine is 58 inches. Equipped with a 75-horsepower motor, the machine will absorb the full motive power without difficulty, having been so designed throughout that should increased power be required, it may be readily equipped with a 100-horsepower motor. The gearing is amply capable of transmitting this extra power should it be called upon to do so. Special attention was given, in designing the machine, to the obtaining of a smooth cutting action, suitable range of table feeds for the work, convenient manipulation, and thorough lubrication.

The spindle is driven by a large manganese bronze worm-wheel of coarse pitch, which engages a hardened steel worm provided with a ball thrust bearing. The spindle driving arrangement is illustrated in Fig. 2, which shows the rear view of the machine. Both the worm and the worm-wheel run in a bath of oil. The use of a large-diameter worm-wheel gives a smooth cutting action. As illustrated, the machine is equipped with a variable-speed direct-current motor drive, which provides a simple driving arrangement, as the motor used has the range of speeds required by the cutter-arbor, and the full speed range is obtained without the necessity of change-gears.

There are the usual power feeds and fast power traverse for the table along the bed, the power being supplied by a separate motor seen on the operating side of the machine in Fig. 1. The power is transmitted by a bronze spiral pinion which runs in a pocket of oil and engages a steel rack on the under side of the table. There is a rapid power adjustment in both directions for the cross-rail, as well as a power vertical feed for raising the cutter from the work. The downward feed is manually operated to safeguard against breaking the cutters when lowering them on the work. Both the power feed and rapid adjustment are driven by the same motor, which is so wired to the driving motor panel that it stops when the driving motor is stopped. However, a power rapid traverse of the table or rail can be obtained when the driving motor is not in operation. The feed motor has a special control by means of which the pulling power is slightly eased off when the cutter meets unusual resistance,

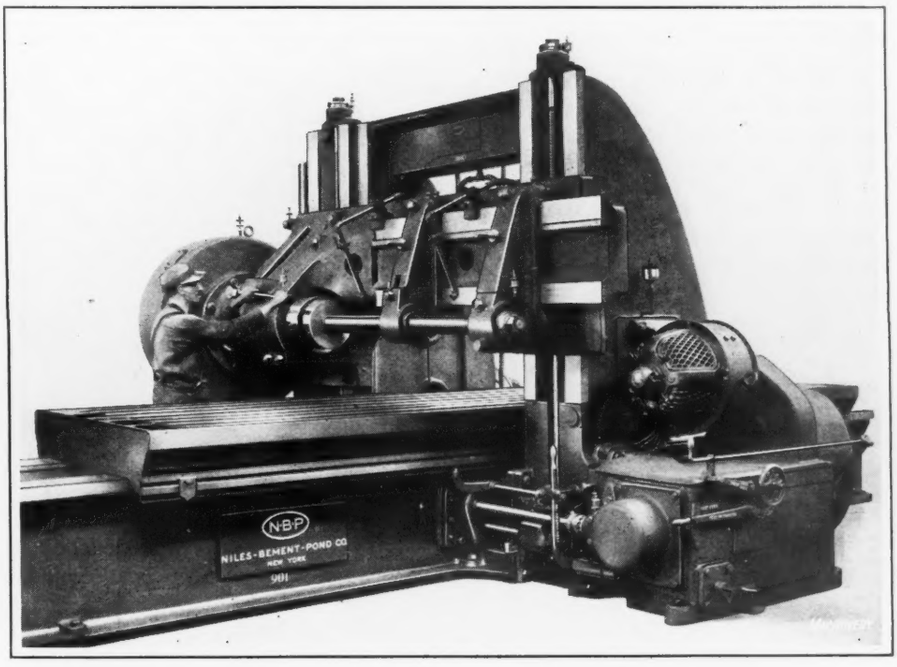


Fig. 1. Bement Heavy-duty Locomotive Rod Milling Machine

due to excess metal or hard spots. This is a valuable aid in preserving cutters.

The machine is equipped with a cutting fluid circulating and draining system. The fluid flows to the cutters by gravity from a tank in the top cross-piece between the housings, and drains from the table to a lower reservoir, from which it is pumped back to the tank. When an alternating-current or a constant-speed motor only is available, suitable change-gearing is supplied. The width of the table over-all is 54 inches; the length of the table between the end pans, 16 feet; and the maximum distance between the table and the center of the arbor, 32 inches.

FEDERAL CYLINDER GAGE AND INDICATORS

A test gage equipped with an indicator having a dial that shows variations of 0.0001 inch in the diameter of automobile cylinder bores, is now manufactured by the Federal Products Corporation, 15 Elbow St., Providence, R. I. In general details of construction, this gage is similar to the one described in November, 1919, MACHINERY, but that gage was provided with a dial reading only to 0.001 inch. As seen in the illustration, the improved gage has three "feelers" at the right-hand end, which are set radially to a master ring before being placed in a cylinder bore. When the feelers have been set, the face of the indicator is turned until the hand registers zero, after which the feelers are placed in the bore and applied to any portion of it. The instrument is rocked from side to side in the operation of testing, and while this is done the readings of the gage indicate the error at the point where the feelers are applied in the bore.

This indicator is also furnished separately in a model T for other applications, with one of three dials. The first dial is graduated from 0 to 100 plus and minus, similar to that shown; the second, from 0 to 200 direct-reading; and the third, from 0 to 200 with a second hand. The dial is set relative to the hand by turning a knurled bezel, which has a clamp that eliminates danger of accidentally moving the dial after it has been set. The case is a machined brass casting, nickel-plated, and the mechanism is the gear-and-pinion movement supplied in other indicators made by this company.

In Fig. 2 is shown a 0.0001-inch indicator mounted on a base or stand to facilitate gaging operations. The range between the point and the anvil is ⅜ inch. The spindle of the indicator can be raised and held in any desired position by loosening the knurled thumb-screw at the top and then turning the collar. This permits the rapid insertion of work between the anvil and the spindle point. Both the anvil and spindle point are ground to a slight taper so that when a part is placed between them, the spindle will raise itself to the desired position.

The small knurled nut on the right-hand side of the spindle and anvil housing holds an adjustable pin which can be set to any desired distance between the bottom of the jaw housing and the anvil, and acts as a stop, so that the piece being measured will always rest at the highest point. On the back of the indicator is another knurled set-screw by means of which the indicator can be swung on the stand to any angle to suit the operator.

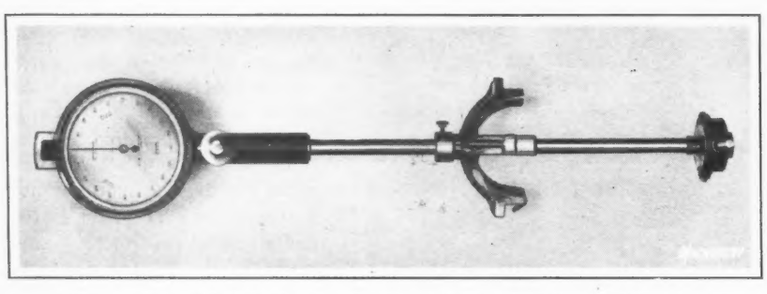


Fig. 1. Federal Cylinder Gage equipped with Indicator reading to 0.0001 Inch

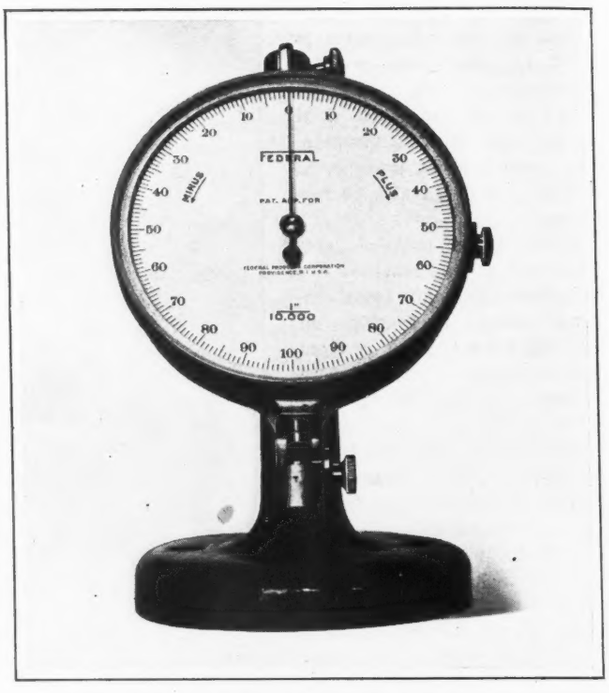


Fig. 2. Indicator Gage mounted on a Stand

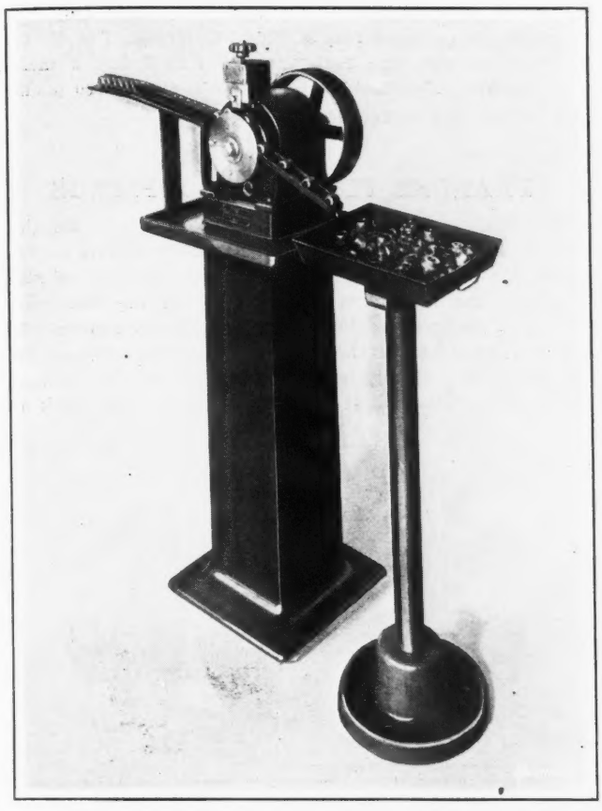
NOBLE & WESTBROOK DIAL-FEED MARKING MACHINE

A new type of marking machine intended for stamping sizes, trademarks, and other designs upon bushings and similar cylindrical pieces of various diameters and lengths, constitutes the latest development of the Noble & Westbrook Mfg. Co., Hartford, Conn. This machine is especially intended for use where rapid production is desired in marking. It is simple and positive in action, the work traveling continuously in one direction from the feeding chute to the marking die, and then being delivered into a receptacle.

There is a steel stamp attached to the face of a small vertical slide at the top of the machine, and this stamp is set to suit the diameter of the work. After loosening a binding screw, the stamp may be adjusted up or down by means of the small handwheel, to make the impression lighter or heavier or to set the stamp for another size of work. The principal moving part of the machine is the dial which revolves continuously. This member is made of tool steel, hardened and ground, and has a number of V-shaped notches around the periphery. Thinner disks of soft steel in front and back of the dial, position the pieces of work endwise as they roll from the feeding chute into the notches in the dial.

The face of the stamp is concave to conform to the arc of the work surface being stamped. As the pieces pass under the stamp they are first stopped by it and then rotate in the V-shaped seat of the dial in the same manner that the pinion of a planetary gear train rolls between the central driving gear and the outer ring gear. The dial is driven through back-gears from the pulley at the rear of the machine, these gears having a ratio of 1 to 15, so that ample power is supplied by a 2-inch driving belt.

The machine has a capacity for marking pieces up to 1¼ inches in diameter, but larger diameters can be handled by sub-

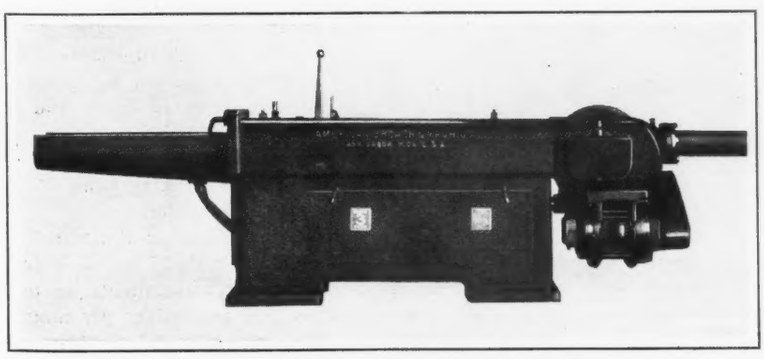


Noble & Westbrook Dial-feed Marking Machine for Cylindrical Work

stituting another dial, and various lengths can be accommodated by adjusting the outer retaining disk toward and away from the dial. One of the main features is the rapid marking, the output being determined solely by the ability of the operator to keep the chute filled with work. Marking from 6000 to 7500 pieces per hour is considered a comfortable working speed. The machine requires a floor space of only 15 by 30 inches, and weighs approximately 225 pounds with the pedestal. Short legs may be substituted for the pedestal to facilitate mounting the machine on a work-bench.

AMERICAN RACK-TYPE BROACHING MACHINE

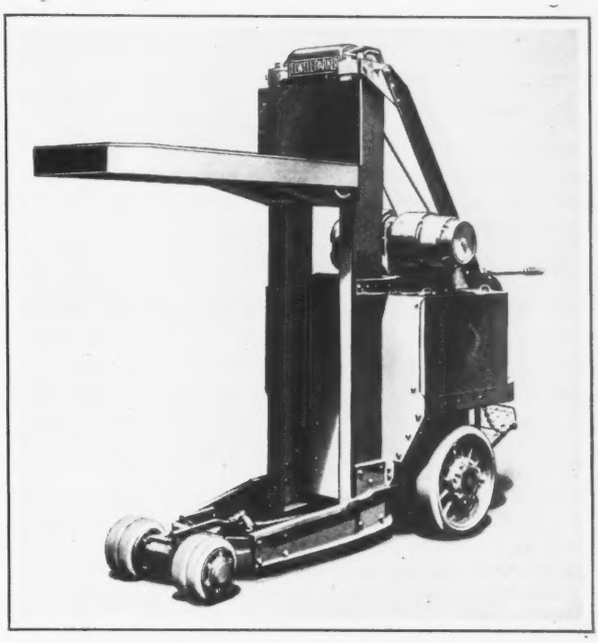
The No. 3 motor-driven rack-type broaching machine here illustrated is now being introduced to the trade by the American Broach & Machine Co., Ann Arbor, Mich. The motor is suspended from the gear-case at the right-hand end of the machine, and drives through a silent chain. The drive in the machine is the same as in the standard American rack-type broaching machine, being through a hardened worm, bronze worm-gear, and hardened pinions which engage a D-shaped rack. The machine will make a complete stroke with a 4-foot broach and return to the starting position in approximately twenty-four seconds, the return stroke being three times faster than the cutting stroke. The machine is equipped with automatic stops which are adjustable to suit any desired length of stroke, and broaches up to 58 inches long can be accommodated.



American Motor-driven Rack-type Broaching Machine

ELWELL-PARKER "TRUCTOR"

The "Hi-Lo Tructor" here illustrated is the latest addition to the line of electric industrial trucks built by the Elwell-Parker Electric Co., Cleveland, Ohio. This equipment will not only pick up, transfer, and set down a loaded skid, but will also take a load at any height up to 6 feet, deliver, and deposit it on the floor or on any level up to 6 feet. It will handle loads weighing up to 6000 pounds. As the elevator platform is designed to receive loads near the floor, there is little room for mechanism beneath the platform. The platform consists of a cantilever built of heavy formed plates and two steel arms. Each of the arms carries two large rollers at the supported ends, the rollers being fitted with double-row ball bearings. The lower or forward rollers



Elwell-Parker Heavy-duty Electric Elevating "Tructor"

just beneath the platform travel on machined ways on the face of channel uprights, while the upper rollers bear on machined ways on the rear side of the channels.

The two platform arms also carry the moving part of the hoist mechanism, and this counterbalances a portion of the platform weight. Elevation of the load deck is accomplished by means of a motor connected to a double-grooved hoist drum, which forms a self-contained unit located over the battery compartment. A safety or trip switch is provided to automatically limit the travel of the platform, and this opens in case the platform strikes an obstruction in descending. When the loaded platform descends, it drives the hoist motor as a generator to replenish some of the power drawn from the battery in raising the load. The front axle consists of a heavy steel casting bored and fitted with a steel axle which carries two cupped wheels on knuckle pins. The tires are not pressed on the wheels, but are fitted in such a way that they have a differential action when the wheels are steered. The truck with the battery weighs about 5200 pounds. It travels at from 300 to 400 feet per minute, and hoists at speeds of from 5 to 6 feet per minute.

Hunter Ratchet Drilling Device

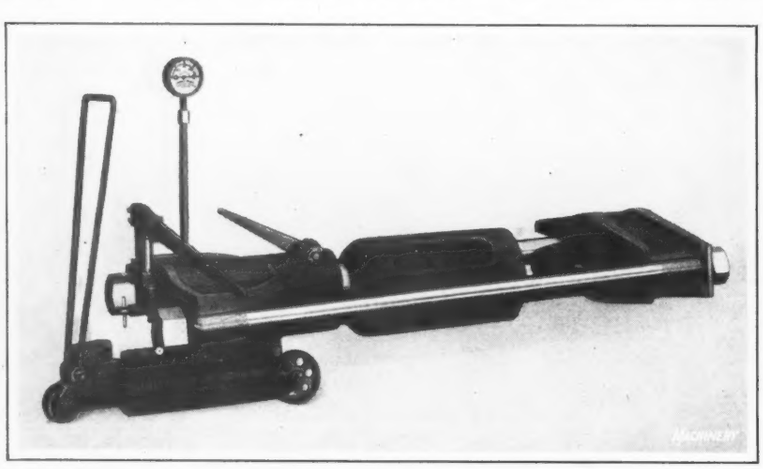
HUNTER DRILL

For drilling holes in places where it is impracticable to use power-driven equipment, the James Hunter Machine Co., North Adams, Mass., is manufacturing a ratchet type of hand drill. This device may be employed in places where there is a clearance of only two inches. It is clamped to the part to be drilled and may be positioned at any angle, there being three positive adjustments which are obtained by applying a wrench. The equipment may be used for drilling holes ranging from ¼ to 1¼ inches in diameter, and is particularly suitable for use in places remote from electricity and air supply lines.

ELMES LOCOMOTIVE CRANKPIN PRESS

For forcing locomotive crankpins in or out without removing the drivers, thus permitting these operations to be performed while the locomotive is on the track, the Charles F. Elmes Engineering Works, 222 N. Morgan St., Chicago, Ill., have developed the portable press here illustrated. While this equipment is especially intended for roundhouse service, it is also adaptable to many operations in machine shops when it is equipped with a resistance head made up from an I-beam or steel casting such as are commonly used on portable forcing and wheel presses. The illustration shows the resistance head mounted on the equipment for forcing out a locomotive crankpin, the hollow cylindrical spacer between the columns being placed over the crankpin and against the driver for the operation.

The resistance head is reversed on the equipment for forcing in a crankpin, the opposite side of the head having a projection that permits the pin to extend through the head ready for riveting when the pressure is released. The pressure pump is of a heavy-duty hand-operated type equipped with a hydraulic gage. This equipment is built in two different capacities—100 and 200 pounds, respectively—each size having a ram stroke of 12 inches. The distance between the ram and resistance head is 3 feet 2 inches. The weight of the smaller sized press is about 1000 pounds, and that of the larger press, 1910 pounds.



Elmes Portable Press for forcing Locomotive Crankpins in or out

FRANCKE FLEXIBLE COUPLINGS

Two flexible couplings recently brought out by Smith & Serrell, 46 Central Ave., Newark, N. J., are shown in Figs. 1 and 2. That shown in Fig. 1 is made entirely of steel, especially for high-speed drives. One of the features is that it is easily accessible for inspection and repairs without moving either of the machines that the coupling may connect. The flexibility is obtained by the use of a laminated spring construction. It is an easy matter to check the alignment of the coupling members by simply measuring across the flanges either with the center flexible member in place or removed.

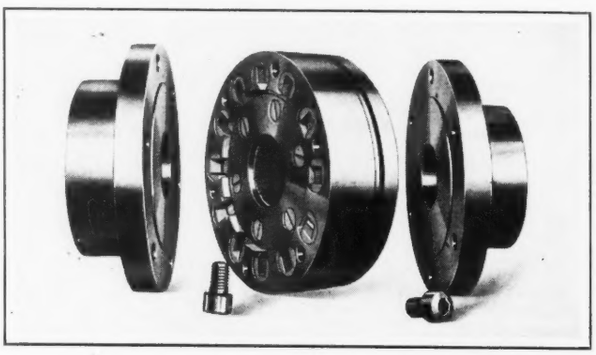


Fig. 1. Francke Flexible Coupling for High-speed Drives

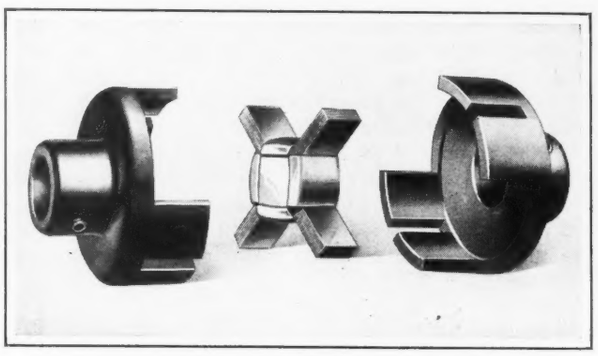


Fig. 2. Pressed-steel Coupling for transmitting a Fractional Horsepower

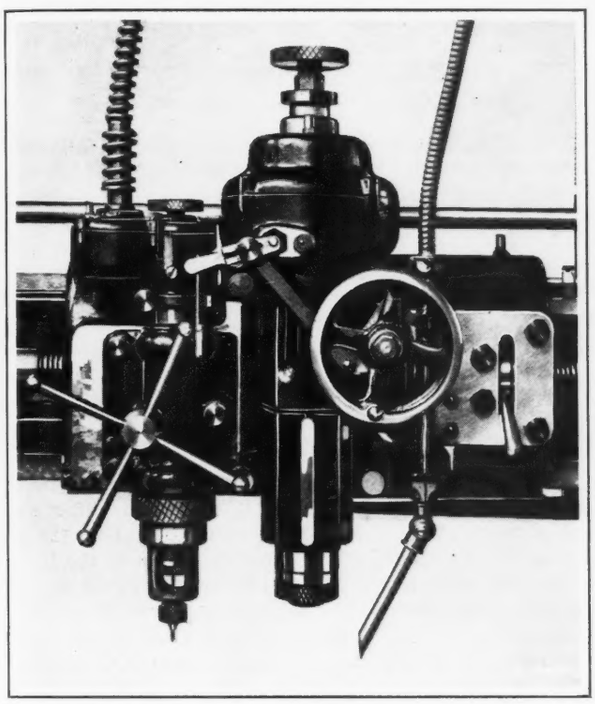
The keepers in the outer member for the laminated spring can rotate as well as slide endwise in this outer member. Thus the bearing between the bundle of springs and the keeper is constant, and is a surface bearing rather than a line or point contact. The bundle of springs can slide both vertically and horizontally, so that the construction provides flexibility in all directions. As this type of coupling is intended for operation at high speeds, some method of lubrication should be provided. Grease is suitable for some drives and oil for others; so the coupling is built to retain either oil or grease. The coupling is made in a number of sizes ranging from 5⅜ to 16⅛ inches outside diameter.

The pressed-steel coupling illustrated in Fig. 2 is intended for shafts up to ¾ inch in diameter and for transmitting up to 1 horsepower at 1800 revolutions per minute. This is a three-part all-metal flexible coup-

ling consisting of two similar pressed-steel flanges and a center spring cross. It is flexible in all directions, as well as extensible endwise. The outside diameter is 2¼ inches; the over-all length, 2⅜ inches; the space between the ends of the shaft, ⅞ inch; and the length of the shaft fit, ¾ inch.

SOCIETE GENEVOISE HIGH-SPEED DRILLING ATTACHMENT

An attachment has been developed to facilitate the high-speed drilling and boring of small holes in jigs and fixtures on the two larger sizes of locating and jig boring machines built by the Société Genevoise d'Instruments de Physique of Switzerland, whose American agent is the R. Y. Ferner Co., 1410 H St., N.W., Washington, D. C. These machines, which have a capacity for jigs up to 16 by 24 inches and 24 by 32 inches, respectively, are regularly equipped with a boring spindle mounted on a slide which

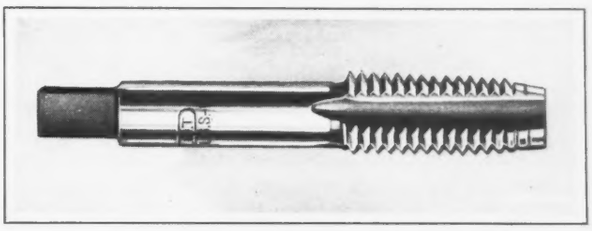


High-speed Drilling Attachment for Use on Jig-boring Machines

is actuated by an accurately compensated lead-screw. This spindle is capable of boring holes up to 3 inches in diameter in cast iron on the No. 4 machine, and up to 4 inches in diameter on the No. 5 machine.

The new attachment consists of a second spindle which is mounted on the same slide as the main spindle at a fixed distance from the latter and parallel to it. This spindle is designed for drilling holes less than ¼ inch in diameter. It is driven by a flexible shaft connected to the main drive of the machine through a friction clutch, and is started and stopped by means of a lever. The spindle can be operated at as high a speed as 2000 revolutions per minute. It is often necessary to locate and drill small holes on a large jig at definite distances from other holes or a surface, and with this attachment such operations may be easily performed without disturbing the setting of the work on the machine.

The vertical travel of the attachment spindle is about 1.6 inches, and is controlled by a cross-handle which operates through a rack and pinion. The movement of the spindle can be measured by means of a graduated scale on an upright stem. An adjustable ring having an indexing feature can be used as a stop to limit the vertical movement to any desired amount. The small drills are mounted in special conical chucks in which they are clamped by means of a milled ring. To prevent the lower end of the small drills from vibrating at the high speeds, a special guide has been provided which holds this end true within close limits. This guide is clearly shown in the illustration.



Flanders Ground Tap

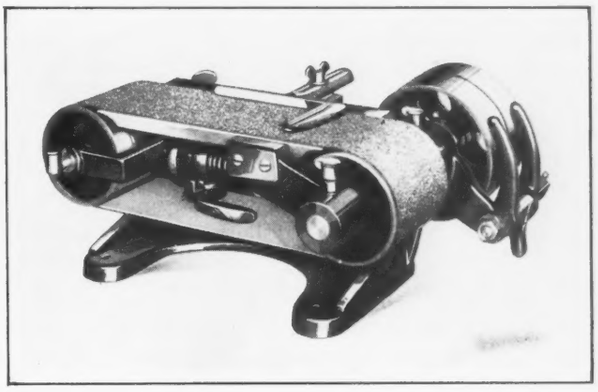
FLANDERS GROUND TAPS

A line of "Flanders" ground taps is now being manufactured by the Jones & Lamson Machine Co., Springfield, Vt., in which the shank and thread form are ground to accurate shape and dimensions after the taps have been hardened. In this way, all distortion, such as warping of the teeth and bending of the taps, due to the hardening process, is corrected. The taps are made from high-speed steel. It is stated that a pitch diameter tolerance of 0.0005 or even less, can readily be maintained by the grinding process employed by the manufacturer, but that tolerances smaller than 0.0008 inch are impracticable. The lead error is held within plus or minus 0.0005 inch. The limits are based on the "close fit" of the National Screw Thread Commission, and with proper lubrication, alignment, cutting pressure, and ordinary materials, the taps will produce holes within the limit of that fit. The taps are regularly carried in stock from ¼ to 1 inch in diameter in fine and coarse thread series, but taps varying from the standard dimensions can be supplied.

WALLS ABRASIVE BAND GRINDER

An improved abrasive band grinder equipped with tight and loose pulleys, which is known as the "Simplex A," has been placed on the market by the Walls Sales Corporation, 96 Warren St., New York City. Besides the regular quick-change band feature, this grinder is equipped with an extra outboard bearing and a shifter fork that is movable to suit various belt angles. The abrasive band can be quickly changed while the machine is in motion by pulling out the lever to draw in one pulley and thus release the band.

The working table is planed level and is 10¼ inches long by 5 inches wide. A 4-inch belt is used which may be moved to an advantageous position on the pulleys as needed by simply adjusting two thumb-screws on the rear of the equipment. The maximum power required for this grinder is ½ horsepower when the 5½-inch pulleys with which it is equipped are revolving at a speed of 1100 revolutions per



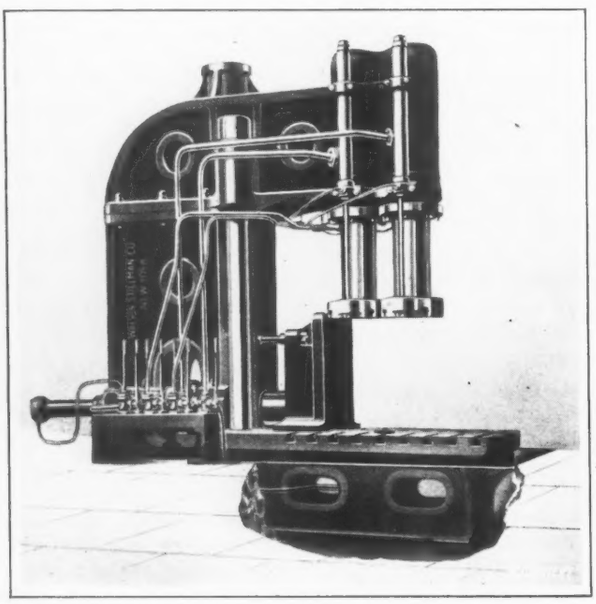
Walls Improved Abrasive Band Grinder

minute. The grinder may be used for roughing, smoothing, or finishing metal parts, and is also recommended for use on parts made of hard rubber, fiber, celluloid, bakelite, etc.

WATSON-STILLMAN PLATE FLANGING PRESS

A line of built-up hydraulic plate flanging presses has recently been brought out by the Watson-Stillman Co., 192 Fulton St., New York City. The term "built-up" is used because the main frame consists of sections securely bolted together. In the past it had been the standard practice to make the main frame in one single casting. Tension strains in the new construction are taken by two heavy columns or bolts, which secure the two parts of the main frame together and reduce the spring to a minimum. Since the overhead casting is subjected only to compressive stresses, it can be made of a lighter section.

In case repairing or replacement of the main cylinders is required, it is only necessary to renew the section of the frame in which they are contained. The return stroke of



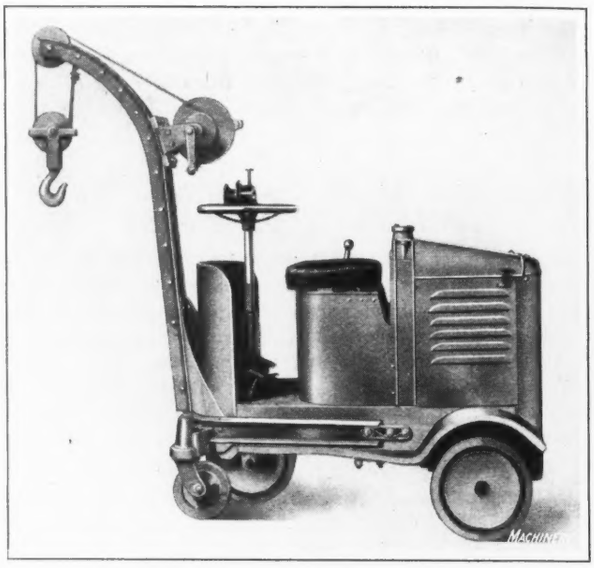
Watson-Stillman Built-up Hydraulic Plate Flanging Press

the main rams is effected by draw-back cylinders below the top of the frame, which reduces the over-all height of the press so that it may be installed in restricted quarters, and allows a crane to be mounted on top of the press to facilitate handling materials.

The presses in this line are usually fitted with two upper vertical rams, one lower vertical ram, and one horizontal ram. The main cylinders are connected through special filling valves to the main pressure line, which permits increased ram speeds to be employed, and at the same time reduces the consumption of the pressure water. The presses are made in different sizes having total pressures on the vertical cylinders of 150, 200, or 300 tons.

CLARK "DUAT TRUCTRACTOR"

A gasoline industrial haulage vehicle equipped with a one-ton crane attachment, which is believed to be the smallest truck or tractor built, is now being introduced to the trade by the Clark Tructractor Co., Buchanan, Mich., under the trade name of "Duat." This tructractor has three wheels, pivoting on one wheel and having a turning radius of 52 inches, which permits it to be turned around in a box car. It will tow from 7 to 10 tons or up to 20 trailers, depending upon the condition of the factory floor or yard.



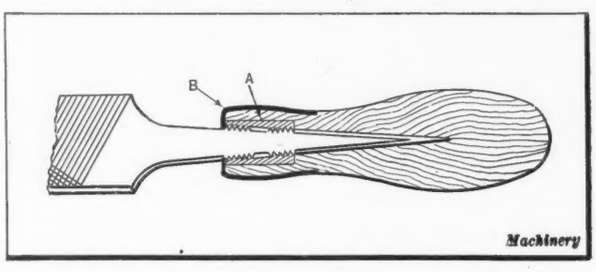
Clark Combination Truck, Tractor, and Mobile Crane

Through an ingenious device the crane may be attached to the tructractor without the use of tools in less than five minutes, converting the truck into a mobile crane. A braking device permits of carrying the load at any height up to 56 inches, and the load may be lowered at will. The wheels are 16 inches in diameter and are equipped with 3½-inch solid rubber tires. The wheel-base is 40 inches, and the width of the tread, 33 inches. A brake beneath the seat of the driver automatically stops the truck when the driver dismounts.

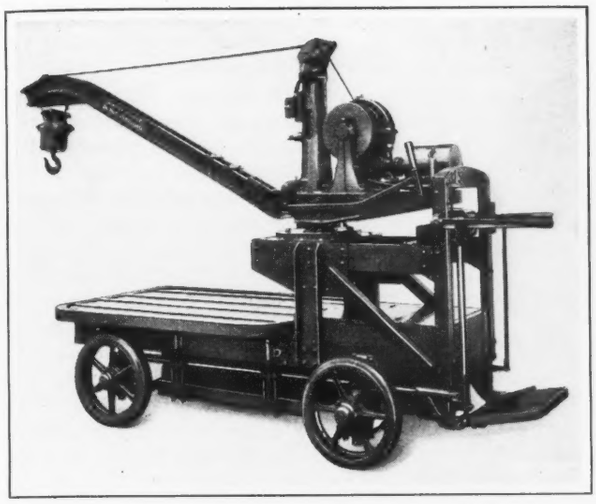
"SKROO-ZON" FILE HANDLE

A hard wood file handle which is held to the file by a novel means is being introduced to the trade under the name of "Skroo-Zon" by the Safety Tool Corporation, 124 E. Moulton St., Watertown, N. Y. As will be seen in the illustration, the wood handle has a tool-steel threaded die *A*, inserted in the front end and the tang of the file is screwed into this die, the end of the tang projecting into a taper hole in the handle. By this arrangement the file is securely held after it has once been screwed into place. The outside of die *A* is hexagonal, and the hole in the handle which receives it is of similar shape so that the die cannot turn. The pressed-on ferrule *B* guards against the die being pulled out of the handle and eliminates splitting of the wood.

After a file has been worn out, the handle can quickly be removed and a new file screwed on. Among the advantages claimed for this handle is the fact that the file is more likely to be used for a greater portion of its length because the user need not guard against the handle becoming loose, nor be afraid of injury to his hands as so often occurs when employing a file without a handle. This handle is also suitable for application to such tools as soldering irons and bearing scrapers which have a tang.



"Skroo-zon" File Handle with Threaded Die into which Tang of File is screwed



Crescent Industrial Truck equipped with Revolving Crane

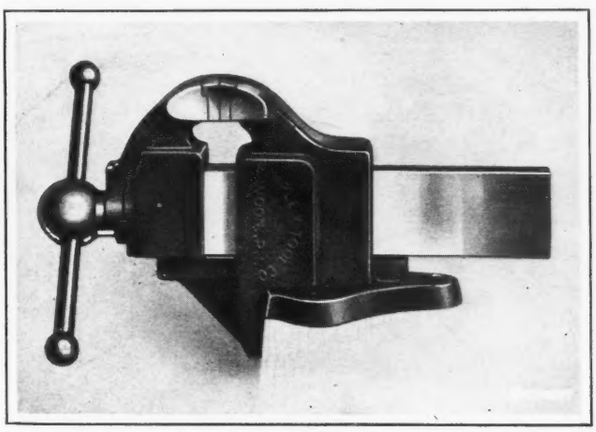
CRESCENT INDUSTRIAL CRANE TRUCK

A type GC industrial truck equipped with a crane that has a lifting capacity of 1500 pounds and that swings through an arc of 180 degrees, so it can pick up a load on either side or one end of the truck, is built by the Crescent Truck Co., Lebanon, Pa. The crane is of a compensating type, with four fixed positions. The power unit of the crane is of the worm-driven type, and is operated through a standard drum controller. There are circuit breakers attached. The truck has a sufficiently small turning radius to permit it to enter the side doors of a standard box car.

Some of the specifications of this truck are as follows: Dimensions of loading platform, 66 by 44 inches; height of platform above floor, 24½ inches; over-all length, 9 feet 3 inches; turning radius of outside corner of truck, 8 feet 2 inches; length of wheel-base, 4 feet 10 inches; and diameter of tread, 36 inches.

SIMPLEX BENCH VISE

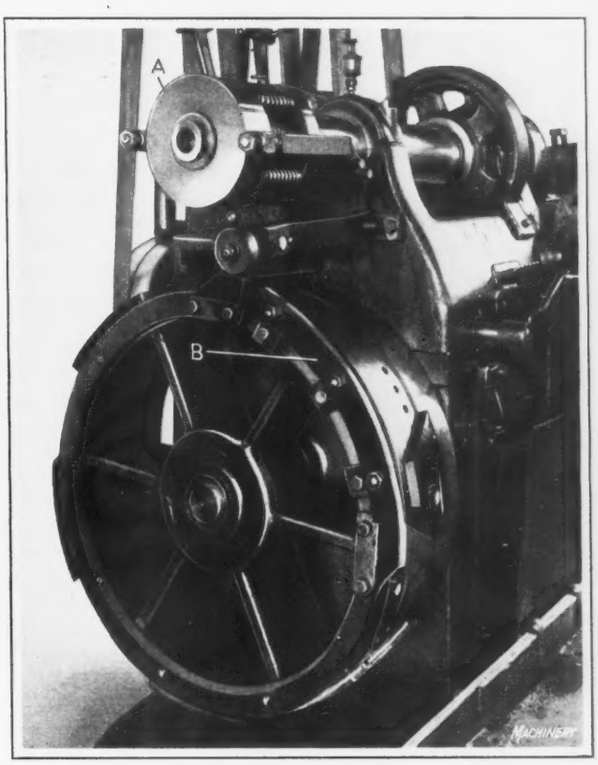
A bench vise known as the "Simplex Gray" is made by the Simplex Tool Co., Woonsocket, R. I. The particular feature of this vise is the fact that it is provided with an all-steel slide for the purpose of eliminating breakage. The body is cast of a tough grade of crucible iron, and the jaws are made of steel, hardened and ground. The square-thread screw is made of steel, and is retained in place by a cap in front of the sliding jaw. This construction eliminates the necessity of coring the inside of the vise to receive a collar. The nut can be easily replaced. This vise is made in a number of sizes, from 3 to 7 inches.



Simplex Bench Vise

GIDDINGS SPRING-OPERATED CHUCK CYLINDER

A spring-operated chuck cylinder of comparatively simple design but having an effective gripping power has been developed by George Giddings, 35 Myrtle St., Springfield, Vt., for application to automatic screw machines and turret lathes. This cylinder is shown at *A* in the illustration applied to a Gridley single-spindle automatic turret lathe for operating the chuck jaws. The operation is the same as with an air cylinder except that the necessary pressure is obtained by means of springs instead of air. This spring cylinder is constructed so that it will readily replace air cylinders, but it requires a special cam for operating it. This cam *B* is attached to the end of the main drum. The cam operates the jaws of the chuck through the medium of a roll and bell-crank lever and then through pull-rods which operate the rear sleeve. Attached to this sleeve is an inner sleeve which, in turn, is connected to the pull-rod that operates the chuck jaws. The illustration shows the cam in the position that it occupies when the chuck has just been opened. The jaws are closed when the lower portion of the cam reaches the roll.

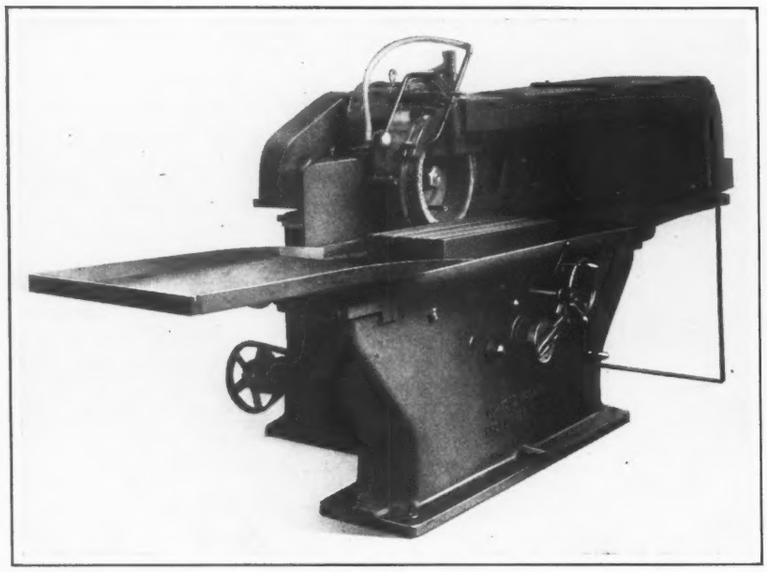


Giddings Spring-actuated Chuck Cylinder installed on a Gridley Automatic Turret Lathe

The features claimed for this cylinder are simplicity of design and effectiveness of operation. It is said to have a gripping power capable of handling the heaviest boring and turning operations that a turret lathe would be called upon to perform. The action of closing the jaws on the work does not exert any end pressure on the machine spindle. As the cylinder is self-contained, it can be used in any shop, and requires no attention on the part of the operator, after it has once been set up.

DIAMOND EIGHTEEN-INCH FACE GRINDER

An 18-inch size has recently been added to the line of face grinding machines built by the Diamond Machine Co., 9 Codding St., Providence, R. I., in order to accommodate small work and thus release larger machines for work



Diamond 18-inch Face Grinding Machine

more suited to their capacity. The wheel is of the solid ring type, 18 inches in diameter, and has a 15-inch bore. It is held in a steel-bound chuck, and carried by a 3½-inch spindle which is supported in adjustable phosphor-bronze bushed bearings and equipped with ball-thrust bearings.

A 10-horsepower motor running at 1800 revolutions per minute is used for driving the abrasive wheel through a sprocket and silent chain. There is also a ¾-horsepower motor running at 1200 revolutions per minute which drives the table through 2-inch belts. The table is equipped with a hand-operated cross-feed from front to rear. All table driving gears are made of steel, and the teeth are cut from the solid. The machine is built in sizes having a capacity for grinding work from 24 to 60 inches in length and up to 10 inches in height, but in case of necessity, the guard flap may be removed for grinding work up to 14 inches in height. The width of the table is 14 inches. There is a main tank in the column which holds thirty gallons of water.

LEBLOND GEARED-HEAD RAPID-PRODUCTION LATHE

A recent addition to the line of lathes built by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, is a 17-inch heavy-duty geared-head rapid-production lathe. In many respects this new size is similar to the LeBlond 11-inch rapid-production lathe described in July, 1922, MACHINERY. The headstock is of the selective-speed type providing six changes ranging from 50 to 250 revolutions per minute, from a constant-speed driving pulley. This pulley is connected to the driving shaft by means of an automobile-type multiple-disk clutch which runs continuously in oil and is operated by the lever at the front of the headstock. The friction unit is composed of interspaced molded "Raybestos" and ground steel plates, and there are three heavy coil springs which not only separate the plates when this clutch is disengaged but also apply a cone friction brake immediately upon the release of the clutch, to bring the spindle to an instant stop. The various spindle speeds are obtained by the manipulation of two levers.

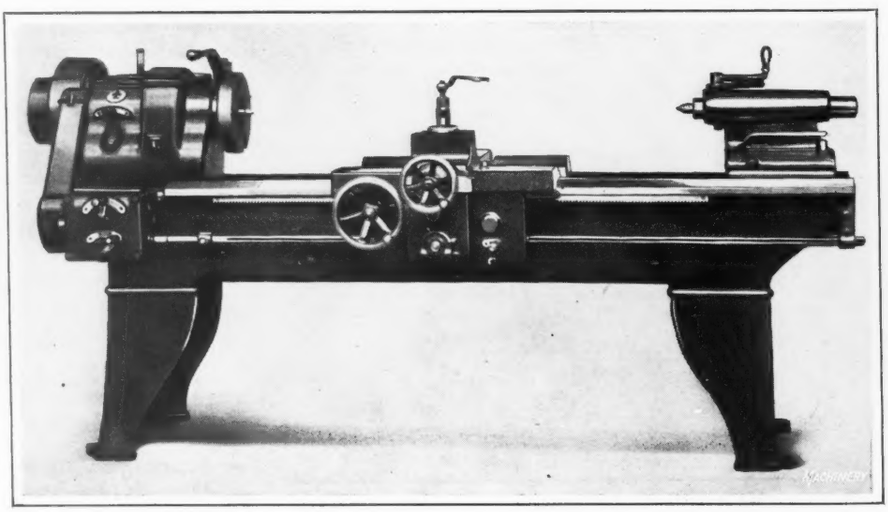
The apron is a one-piece box-section casting in which all gears and shafts are supported at each end. It is equipped with a single patented positive-jaw clutch for controlling both the longitudinal and transverse feeds. The bed is provided with the LeBlond "improved compensating vee."

Nine feed changes of the carriage ranging from 0.010 to 0.123 inch per revolution of the spindle are obtainable by means of two levers, the bottom lever compounding the range obtainable through the top one. The feed mechanism is driven direct from the spindle by a heavy roller chain which is adjustable for tension, the drive being enclosed in a cast-iron guard. The turret toolpost can be furnished to order. The stud on which the turret revolves is tapered, and the turret is fitted with a taper bushing so that it can be accurately adjusted to compensate for wear. The locating pin is also furnished with a taper gib in order that this part may always be kept in the proper adjustment.

The lathe can be furnished with a constant-speed belted motor drive, in which case the motor is mounted in the base of a cabinet leg at the head end, in which it is completely enclosed. The drive is then through an endless double leather belt to the driving pulley, an idler pulley being provided for adjusting the belt tension and for increasing the contact area of the belt on the driving pulley. A 5-horsepower alternating- or direct-current constant-speed motor running at 1200 revolutions per minute is recommended. The swing over the shears of this lathe is 18¼ inches, and over the carriage, 12⅛ inches. Work up to 2 feet 9 inches in length can be held between centers when the lathe is built with a 6-foot bed.

GOULD & EBERHARDT MANUFACTURING HOBBING MACHINE

For rough- or finish-hobbing either spur or helical gears in quantity, Gould & Eberhardt, Chancellor Ave., Newark, N. J., have developed the No. 16 H. S. manufacturing hobbing machine, which is readily adaptable to a diversified range of work. In designing this machine, particular attention was given to proportioning and arranging the component parts so as to insure a large production of accurate gears at fast feeds and speeds. Adjustments have been



LeBlond Heavy-duty Geared-head Rapid-production Lathe

provided for maintaining the accuracy of the machine by compensating for any wear that may take place. Transmission of power to the cutter- and work-spindles is effected by a simple arrangement, the power delivered to these spindles being substantially equalized with the object of utilizing and balancing the normal backlash of the parts. The power transmitting mechanism between the two spindles consists of three shafts and four pairs of gears. Each spindle is driven from the prime mover by two pairs of gears, one of which consists of a worm and worm-wheel. The worm-wheels are mounted directly on the spindles.

The transmission of power throughout practically the entire machine is by means of heat-treated alloy steel gears, which are connected to their respective shafts by multiple splines. The index and cutter-spindle worms are hardened and ground. The cutter-spindle worm-wheel is made of a special bronze alloy, and the index worm-wheel is a chilled iron casting. A diagram showing the uniformity of the angular velocity ratio between the cutter- and work-spindles obtainable with the method used for transmitting power to the two spindles is illustrated in Fig. 2. The accuracy of the gears cut depends upon the correctness of the ratio of this velocity. A description of the method followed in making a test of this sort was described in December, 1922, MACHINERY.

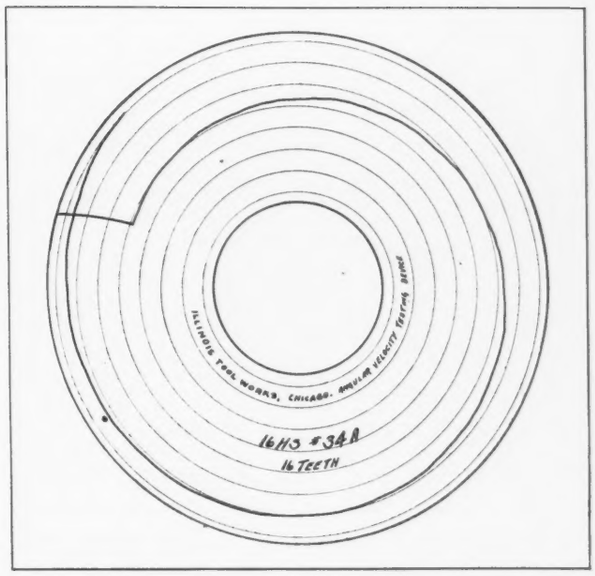


Fig. 2. Diagram showing the Uniformity of the Angular Velocity Ratio between the Work- and Cutter-spindles

The arrangement of the controls on the operating side of the machine, in relation to the work and cutter, is clearly shown in Fig. 1. The controls have been so located within the reach of the operator that it is unnecessary for him to move from one position for reloading or operating. There are three operating levers, one for controlling the main power-transmission clutch for starting and stopping the machine, another for controlling the power traverse of the cutter carriage in either direction, and the third for starting and stopping the feeding motion of the cutter. One of the handwheels is used for moving the cutter carriage a small amount, and the other for positioning the stanchion for the proper depth of cut or for different diameters of gear blanks. The power traverse for the cutter carriage in either direction is at the rate of 100 inches per minute, and this movement can be obtained whether the cutter- and work-spindles are revolving or not.

The rapid-traverse operating lever is so interlocked with the feed-lever that neither the feeding movement nor the power traverse can be started without the other movement being first disconnected. There is an additional safety provision which obviates accidental operation of the rapid power traverse downward, and prevents injury of the cutter and blanks. Fixed stops determine the extreme ends of the power traverse in either direction and automatically stop the movement, while an adjustable stop limits the upward movement of the cutter carriage so that the cutter can be stopped at any convenient position for reloading the gear blanks.

A bellcrank and cam device functions in conjunction with the cutter carriage to automatically disconnect the downward power traverse at any predetermined point so as to rapidly position the hob for cutting. This cam device also prevents the engagement of the downward traverse during the cutting operation. Automatic flood lubrication is supplied to the work-spindle, index-worm, and to most of the revolving parts, the lubricant being pumped to an elevated reservoir from which each bearing and gear is flooded. The stanchion is equipped with a multiple gravity oiler from which oil is fed to the moving parts in that unit, while sight-feed oil-cups are supplied for the cutter-spindle and carriage units.

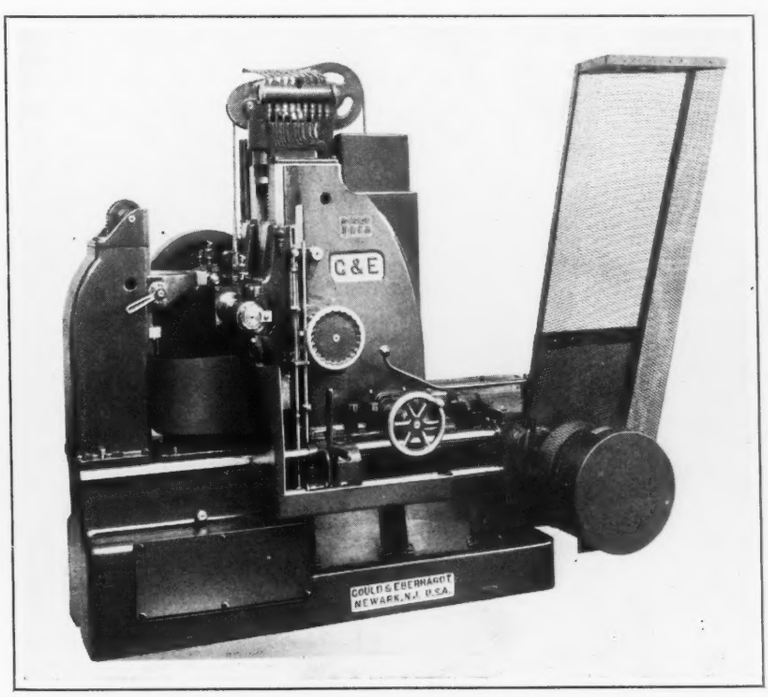


Fig. 1. Gould & Eberhardt Manufacturing Hobbing Machine for Spur and Helical Gears

There is a provision that eliminates any axial movement of the hob due to elongation of the cutter-spindle when running warm, and a separate adjustment is furnished for the taper diametral fit of the cutter-spindle. The work-spindle revolves in a long taper bushing, and the fit in this bushing can be readily adjusted. There is also an independent adjustment for end fit of this spindle. A substantial work-holding surface located at a convenient height on the work-spindle permits easy loading and unloading of the blanks. To serve as an outer support for the end of the work-arbors, there is a rigid box-section casting secured directly to the base. The arbor supporting arm slides vertically on this outer support so that it can be easily moved upward and swung out of the way to facilitate the removal of blanks.

The machine can be furnished either with a fixed angularly positioned cutter-spindle for producing either spur or helical gears of a given pitch, or with a cutter-spindle that has a slight angular adjustment to accommodate different pitches. The machine is rated as having a capacity for cutting

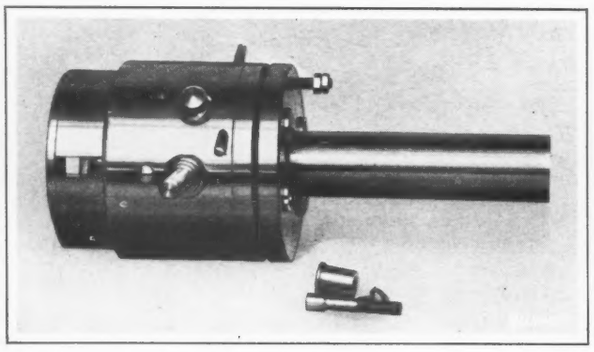


Fig. 1. Style CC H & G Die-head for Cleveland Automatics and Similar Machines

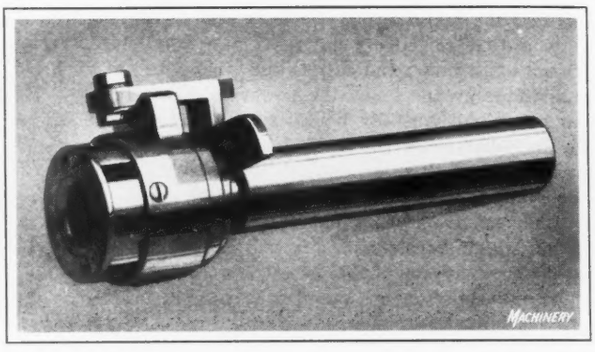


Fig. 2. Style D Die-head manufactured by the Eastern Machine Screw Corporation

gears up to 3 diametral pitch in steel, 18 inches in diameter, and 14 inches face width. There are ten cutter speeds ranging from 50 to 225 revolutions per minute, and the feeds range from 0.01 to 0.25 inch per revolution of the blanks. Special change-gears can be furnished to cut gears having from 3 to 50 teeth, and with slight alterations, gears having from 3 to 160 or 6 to 200 teeth may be produced. The weight of this machine is about 6500 pounds. It is driven by a single pulley which can be belted direct to a lineshaft or to a motor mounted on the rear.

H & G DIE-HEADS FOR CLEVELAND AUTOMATICS

For use on Cleveland automatic screw machines and similar machines, the Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn., is manufacturing a complete line of H & G self-opening die-heads on which there is an improved method of adjusting for the length of thread cut. Fig. 1 shows the style CC die-head which is available in 9/16-, 1-, 1½-, 2-, 2½- and 3-inch sizes, while Fig. 2 shows the style D head which is available in the smaller sizes of ¼-, 7/16- and 9/16-inch.

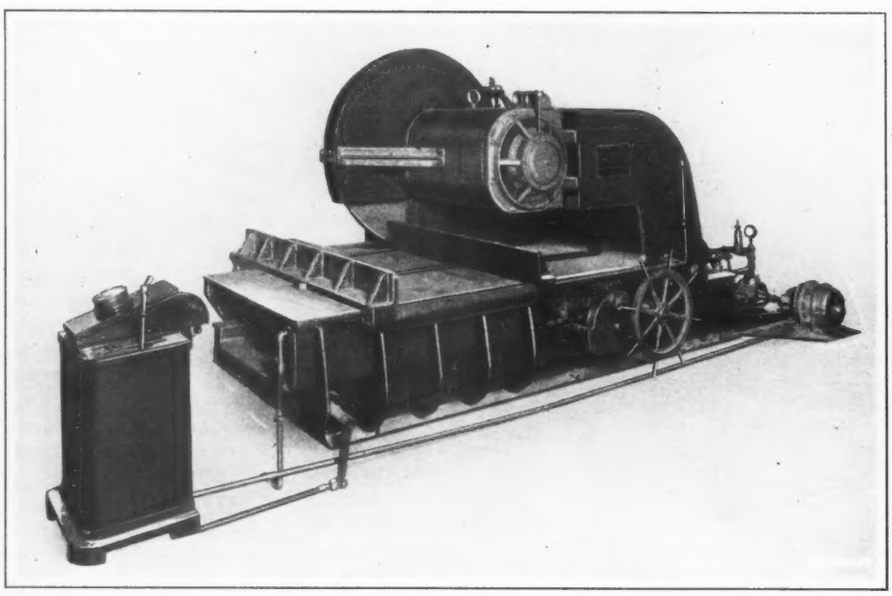
The style CC head has longer guide pins than the style C head made by the same concern for use on hand screw machines, and the locking pin is provided with an adjusting nut and lock-nut. When the forward movement of the turret or tool-holder ceases, the die continues to cut the thread until the forward movement of the locking pin is stopped by the adjusting nut coming into contact with the flange on the shank. When this occurs, the die-head opens immediately. It will be apparent that this adjustable tripping mechanism is of simple and strong construction.

The heads are closed automatically by means of a closing stud or lug, which comes into contact with an overhanging arm of the machine as the turret rotates. On the style D head the fine adjustment for length of thread is self-contained on the arm extending from the shank and overhanging the head.

RYERSON FRICTION SAW

A friction saw designed for handling the largest structural steel section rolled has recently been added to the line of friction saws built by Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill. This No. 5 saw was developed for heavy-duty service in large shops, steel warehouses, and mills. An idea of its capacity may be gained from the fact that it is driven by a 125-horsepower motor, while heretofore the largest saw built by this company was equipped with only a 60-horsepower motor. The new saw takes a 61- by ⅜-inch blade, and has a vertical clearance of 14¾ inches under the hood and flanges.

The machine is of the same general type as previous machines built by the company, except that three rollers have been added to the cutting table to facilitate handling the heavier sections. There are two levers mounted on a control box that may be situated where most convenient for the operator. One of these levers controls the water supply, and the other moves the saw in and out of the cutting table. Feeding is accomplished both by hand and by a hydro-electric automatic means. A voltmeter and an ammeter on the control box keep the operator aware at all times of the load on the motor. Besides the largest structural-steel section rolled, the machine has a capacity for cutting 3½-inch square or 4-inch round stock.



Ryerson Friction Saw which has a Capacity for the Largest Steel Section Rolled

* * *

SPRING MEETING OF A. S. M. E.

Announcement has been made that the spring meeting of the American Society of Mechanical Engineers, which was originally scheduled to be held on May 19 to 22 in Cleveland, has been postponed for a week, the new dates being May 26 to 29, inclusive. The chairman of the committee on local arrangements is Frank A. Scott, president of the Cleveland Engineering Society.

PERSONALS

PROFESSOR W. M. SAWDON, of Sibley College, Cornell University, an engineer by training and profession, has been elected mayor of the city of Ithaca, N. Y.

JAMES A. SMITH, general superintendent of the General Electric Co., Schenectady, N. Y., has been made chairman of the Machine Shop Practice Division of the American Society of Mechanical Engineers for the coming year.

CHARLES D. TERRY, who has been connected with the National Tube Co. since 1897, having been located at the general office in Pittsburg, Pa., as assistant to the general superintendent, since 1911, has become vice-president of the Boss Mfg. Co., Kewanee, Ill.

OWEN D. YOUNG, chairman of the board of directors of the General Electric Co., Schenectady, N. Y., has been selected as a member from the United States of the reparations committee to help balance the German budget and stabilize the mark. Mr. Young sailed for Europe on December 29.

HAYS MCFARLAND, formerly vice-president in charge of sales for the Bassick Mfg. Co., has joined Blackett & Sample, Inc., advertising agents, 58 E. Washington St., Chicago, Ill. Mr. McFarland has become a partner of the concern, and the firm name will hereafter be known as Blackett, Sample & McFarland.

W. A. DONALD, formerly factory manager of the Deep Drawn Metal Corporation, Brooklyn, N. Y., is now in charge of production at the plant of the Vitreous Enamel & Stamping Co., 1381 Sedgwick Ave., New York City. This company has recently expanded its equipment by the installation of a number of new presses.

GLENN A. WILSON has been appointed manager for the New York and New England territory of the Gibb Instrument Co., Bay City, Mich., manufacturer of electric welding equipment. Mr. Wilson's headquarters will be at 120 Liberty St., New York City. He formerly represented the Mutual Electric & Machine Co.

R. E. LUDWICK, formerly sales manager for the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has joined the sales staff of the Whiting Corporation, Harvey, Ill., manufacturer of cranes, foundry equipment, railway specialties, etc. Mr. Ludwick will make his headquarters at the Chicago sales office, 945 Monadnock Block.

J. W. MCIVER has been appointed advertising and publicity manager of the Edison Lamp Works of the General Electric Co. at Harrison to succeed T. J. MCMANIS, who has recentiy been made assistant to the manager of the publicity department of the entire company. Mr. McIver has been employed by the Edison Lamp Works since 1916.

FREDERICK M. BECKET, chief metallurgist of the Electro Metallurgical Co., and vice-president of the Union Carbide & Carbon Research Laboratories, Inc. (both subsidiaries of the Union Carbide and Carbon Corporation), was awarded the Perkin Medal of the Society of Chemical Industry, on January 11, 1924, for his achievements in the field of applied chemistry.

JAMES HARTNESS, president of the Jones & Lamson Machine Co., Springfield, Vt., former governor of Vermont, and past president of the American Society of Mechanical Engineers, was elected president of the American Engineering Council, to succeed Dean Mortimer E. Cooley of the University of Michigan, at the annual meeting of the council held at Washington in January..

JOHN CETRULE, of the Triplex Machine Tool Co., 50 Church St., New York City, has been appointed district sales manager for the B. C. Ames Co., in charge of the New York office, covering the New Jersey and eastern New York territory. A full line of Ames equipment, including bench lathes, bench milling machines, Triplex machines, and dial gages will be carried in stock in the New York office.

SAMUEL T. HARLEMAN, formerly assistant to the vice-president and general sales manager of the Atlas Steel Corporation, Dunkirk, N. Y., has become assistant manager of the steel sales department of Henry Disston & Sons, Inc., Tacony, Philadelphia, Pa. Mr. Harleman, previous to his connection with the Atlas Steel Corporation, was associated with the Bethlehem Steel Co. at its Bethlehem plant, for twelve years.

ALEXANDER MCIVER has been appointed supervisor of heavy traction development of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Mr. McIver has been connected with the company since 1909. Previous to that time he was associated with the Sprague Electric Co., the Chicago & Milwaukee Electric Railway as master mechanic, and the New York City Railways Consolidated Surface Lines as superintendent of equipment. He will make his headquarters at the East Pittsburg works of the company.

NICHOLAS M. DUCHEMIN has assumed the duties of general superintendent of the West Lynn plant of the General Electric Co., following the death of William J. Lloyd on October 28. Mr. DuChemin attended the General Electric apprentice school at the River Works in Lynn and also the engineering school. During the war he enlisted in the navy, and when he was discharged he returned to the Lynn plant of the General Electric Co. as a boring mill hand. He soon won promotion, and his safety work caused him to be put in charge of the Bedeaux point system in the West Lynn plant, which position he occupied when he received his present appointment.

ROBERT W. WHITE, assistant general sales manager of the Linde Air Products Co., manufacturer of oxygen for the welding and cutting of metals, has been appointed general sales manager of the Carbide & Carbon Chemicals Corporation. L. M. ZIMMER, western sales manager of the former company, has been appointed assistant general sales manager to succeed Mr. White. Both Mr. White and Mr. Zimmer will continue to make their headquarters at 30 E. 42nd St., New York City. Other changes made at the beginning of the new year in the executive personnel of the Linde Sales organization include the appointment of E. E. RADCLIFFE as assistant sales manager of the Eastern Division, HERMAN ULLMER as assistant sales manager of the Western Division, and F. E. STOPPENBACH as district sales manager of the New York district.

* * *

ANNUAL MEETING OF AUTOMOTIVE ENGINEERS

The annual meeting of the Society of Automotive Engineers was held in Detroit, January 22 to 25. All the sessions were unusually well attended. Special sessions were held dealing with body engineering, fuel and engines, aeronautics, brakes, motor-truck transportation, research, motor buses, passenger cars, and production. Among the papers of special interest in the production sessions were the following: "Flexible Method of Handling Materials," by A. A. Brown, stock manager, Chandler Motor Car Co.; "Suggestions to Purchasers and Users of Machine Tools," by Thomas Nadin, general superintendent, Rolls-Royce of America, Inc.; "Crankshaft Production Problems," by T. M. Carpenter, manager of the General Motors Corporation's Crankshaft Plant at Saginaw, Mich.; "Reducing Costs by Efficient Management," by T. B. Fordham of the Delco Co., "Hot Swaging," by R. A. DeVlieg, engineer of production, Maxwell Motor Corporation.

In the paper by Mr. Nadin, containing suggestions for the builders and users of machine tools, particular attention was paid to the need for more thorough lubrication of machine tools, and especially for the use and application of automatic lubrication systems. It was pointed out that the simple means used for lubricating bearings in the past are not altogether suitable for present-day machine shop equipment, especially in plants devoted to quantity production. Suggestions were made for better lubricating means suitable to different classes of bearings. Ball and roller bearings were especially dealt with. The question of cutting lubricants was also referred to, and it was pointed out that the problem of proper provisions for cutting compounds is probably simpler of solution than that of providing proper bearing lubrication. A brief account of the correct construction of tanks for lubricants was also given.

* * *

THE RAILROAD SITUATION

The railroads are in a more prosperous condition at present than they have been for many years. Their equipment is in better condition, and they are prepared to handle any business that is offered to them during the coming year. With 4000 new locomotives and nearly 200,000 new freight cars put into service during 1923, a transportation efficiency has been achieved that has never before been equalled. At the end of the year there were still nearly 400 locomotives on order for early delivery. The Chamber of Commerce of the United States estimates that during the next ten years the railroads must spend nearly $8,000,000,000 if they are to meet properly the demands that will be placed upon them. If the railroads are to be able to finance the required improvements, it is important that no adverse legislation be passed to hamper their prosperity. In this connection it is of interest to note that while there have been large increases in freight rates and fares, these increases are proportionately less than those that have taken place in other items that constitute the cost of living.

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Simple fixtures—Short

No. 21 Automatic Milling Machine

If your milling work calls for the rapid production of duplicate parts, you should investigate the increased output secured by using these BROWN & SHARPE Automatic Milling Machines. No. 21 will boost production on some of your lighter jobs.

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The No. 33 is for heavy cuts on large work. Its rigid construction adapts it to the most strenuous demands of present day practice. Speed up production with this sturdy machine.

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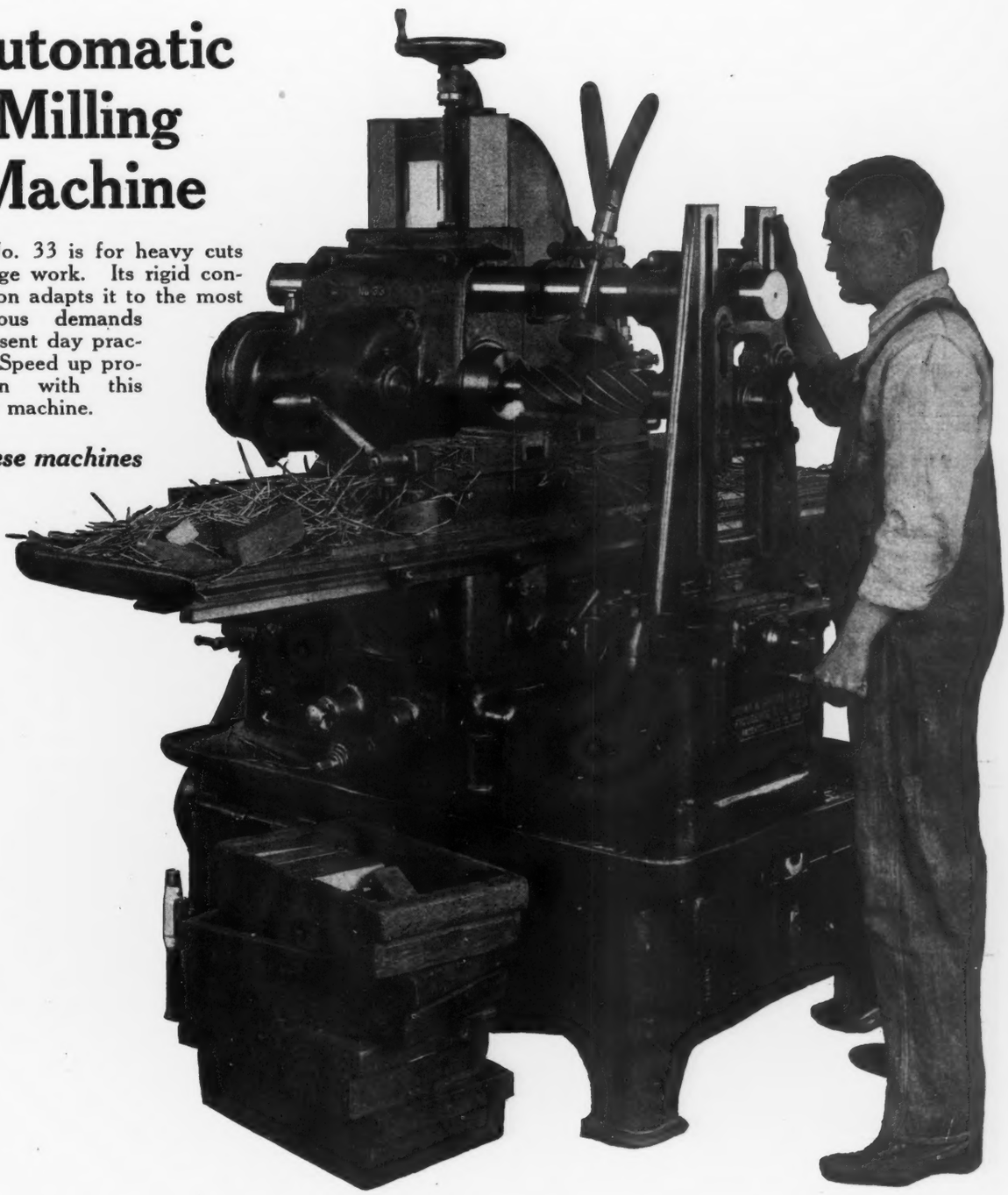


PROVIDENCE, R.I., U.S.A.

OBITUARIES

WILLIAM HERBERT GATES

William Herbert Gates, vice-president and superintendent of the Eastern Machine Screw Corporation, New Haven, Conn., died on December 29, of double pneumonia. Mr. Gates was born in Windsor, Vt., on January 1, 1867. He received his education in the public schools of Milford, Conn., and Worcester, Mass., supplemented by four years of night school work in mechanical drawing. In 1883 he started to work as a milling machine hand in the plant of the Forehand Arms Co., Worcester, of which his father was superintendent. At the age of nineteen he had charge of the screw department and handled all screw machine work. When he was twenty-two he invented his first automatic screw machine and other automatic machines, including a cylinder drilling machine, rifling machines, and screw slotters. He became one of the leading authorities in the country on automatic screw machines.

In 1900 the Forehand Arms Co. was bought out by the Hopkins & Allen Co. and moved to Norwich, Conn. Mr. Gates went to Norwich with the business and had charge of the manufacture of all the small parts and the rifling work. During this period he designed many breech loading and repeating rifles, guns, revolvers, and pistols, and special machinery for firearms work.

In May, 1910, Mr. Gates organized the Eastern Machine Screw Corporation of New Haven. The plant was equipped with his own single-spindle screw machines, which are still in use and giving excellent service. As the result of his work on guns and machinery for manufacturing them, Mr. Gates became interested in high-grade tool methods, which led to the invention, in 1914, of the H. & G. self-opening diehead. During the world war he invented a number of other machines, including the H. & G. threading machine and several special automatic machines.

HERBERT E. CUSHMAN

Herbert E. Cushman, treasurer and general manager of the Morse Twist Drill & Machine Co., New Bedford, Mass., died suddenly on December 27, at his home in New Bedford after an illness of only a day or two. Mr. Cushman was born in Taunton, Mass., January 1, 1862, and was educated in the public schools of that city. He began business life with the Taunton Locomotive Works, for whom he worked as a clerk for one year. He then became head bookkeeper for the Williams Mfg. Co. of Taunton, which position he held for about six years. In 1887 he went to New Bedford and entered the employ of the Morse Twist Drill & Machine Co. as sales agent, in which position he continued until 1902, when he was promoted to the office of treasurer and general manager, succeeding Gideon Allen, Jr., who became vice-president in that year.

During his residence in New Bedford, Mr. Cushman held many other positions of trust. He was a member of the New Bedford Water Board, a trustee of the New Bedford Institution for Savings, and a director of the First National Bank, the Fireman's Mutual Insurance Co. and Union Mutual Insurance Co. of Providence, the New Bedford Foundry & Machine Co., and the Morse Twist Drill & Machine Co. He was also ex-president of the New Bedford Board of Trade, and a member of the American Society of Mechanical Engineers and of the Machinery Club of New York.

Mr. Cushman was married January 22, 1901 to Anna Russell Taber, who died in May, 1922. He is survived by his mother, two daughters, two brothers, and two sisters.

CHARLES R. DOUGHERTY, for the last three years working in the financial interests of the General Electric Co. on the Pacific Coast, died November 27 at his home in Pasadena, Cal., at the age of fifty-one. Mr. Dougherty began his business career when seventeen years of age with the Thomson-Houston Electric Co. in Philadelphia, in a clerical capacity. He later became cashier of the Philadelphia office and, in 1894, was made auditor of the Philadelphia District of the General Electric Co. In 1913 he was transferred to Schenectady as general assistant to the comptroller of the company. In 1920 his failing health necessitated his going to California to live.

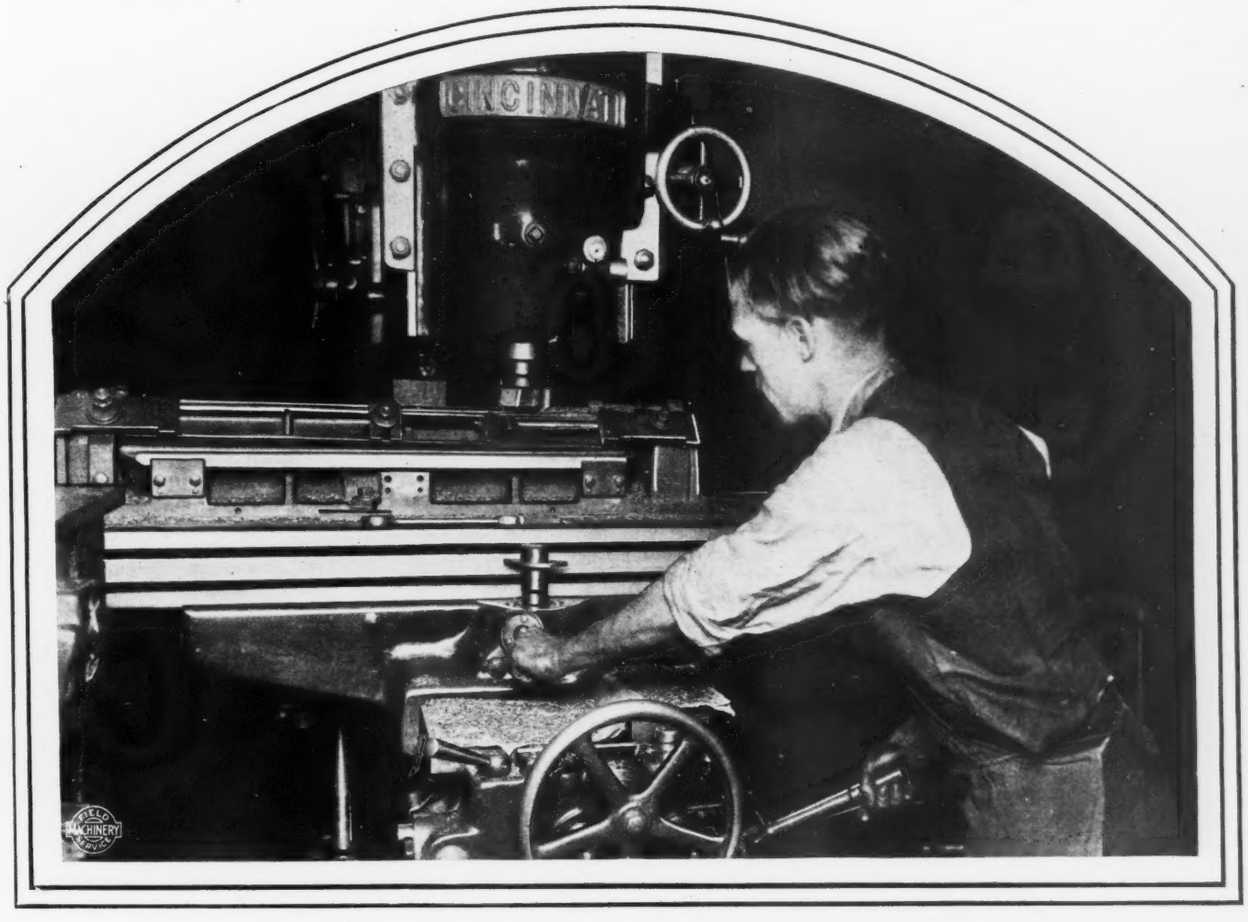
MEETING OF MINING AND METALLURGICAL ENGINEERS

The program of the meeting of the American Institute of Mining and Metallurgical Engineers, to be held in the Engineering Societies' Bldg., 29 W. 39th St., New York City, February 18 to 21, will feature the following papers that may prove of especial interest to the readers of MACHINERY: "Overstrain in Metals," by Joseph Kaye Wood, engineer, New York City; "The Nature of Martensite," by Edgar C. Bain, research metallurgist, Atlas Steel Corporation, Dunkirk, N. Y.; "Corrosion of Brass as Affected by Grain Size," by Robert J. Anderson, metallurgist, Bureau of Mines, Pittsburg, Pa., and George M. Enos, instructor in metallurgy, University of Cincinnati, Cincinnati, Ohio; "Relation of Heat-treatment, Mechanical Properties, and Micro-structure of 60-40 Brass," by Robert S. Williams, associate professor of metallography, Massachusetts Institute of Technology, Victor O. Homerberg, instructor in metallography, Massachusetts Institute of Technology, and Dexter N. Shaw, Research Department, Goodyear Tire & Rubber Co., Akron, Ohio; "Effect of Severe Cold-working on Scratch and Brinell Hardness," by Henry S. Rawdon, physicist, Bureau of Standards, Washington, D. C., and Willard H. Mutchler, laboratory assistant; "Effect on Steel of Variations in Rate of Cooling in Ingot Mold," by William J. Priestley, metallurgical engineer, Electro Metallurgical Sales Corporation, Pittsburg, Pa., "Stainless Steel with Particular Reference to the Milder Varieties," by J. H. G. Monypenny, Chief of Research Laboratory, Brown Bayleys Steel Works, Ltd., Sheffield, England; "Steel Today and Yesterday," by Albert Sauveur, professor of metallurgy and metallography, Harvard University, Cambridge, Mass.

* * *

NEW "SHERMAN ACT" IN GERMANY

In pre-war years German manufacturers had an almost unlimited latitude in regard to making combinations to further their interests, and they were permitted to make agreements and to use collective efforts both in domestic and foreign markets. A new law has recently taken effect, however, which will control German industrial combinations somewhat along the same lines as the Sherman Act does in this country. Under this law, contracts deemed to be contrary to the national economic interests or to the public welfare can be declared void. Any contract in restraint of trade will be considered contrary to the national economic interests, and therefore illegal. The enforcement of the new law is in the hands of the Minister of Economics, and all contracts and agreements between manufacturers regulating the production, distribution, and sale of products must be in writing and must be approved by this official. When in his opinion the contract or agreement is contrary to the national economic interest, he can apply to the courts for an injunction restraining the parties from any action in the enforcement of the terms of the contract or agreement. There is no appeal from the decision of the court when handling matters of this kind.



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USE OUR SERVICE DEPARTMENT

We manufacture thirty-eight different types and sizes of milling machines. Let our Service Department help you select the *right* machine for your particular job. Their recommendations are based on over ten years' experience on this service work.

By a *direct* movement gives any desired rate of feed.

On the job illustrated above, the feed is started at 7¼" a minute and gradually increased as the cut progresses. This the operator does *instantly* with the *single* lever shown in his right hand. When irregularity in the metal makes the cut too heavy, the operator shifts the lever and instantly reduces the feed.

Consider what it would mean to you to have this feature of a single feed change lever located at the operator's normal position in front of the machine.

Send for our booklet fully describing the Cincinnati No. 4 and No. 5 High Power machines, which possess this and many other patented features, all speeding production.

THE CINCINNATI MILLING MACHINE CO.

Cincinnati Established 1884 Ohio, U. S. A.

CINCINNATI MILLERS

TRADE NOTES

CARLE MACHINERY CO., dealer in machine tools, has opened a warehouse and showroom at 546 E. Woodbridge St., Detroit, Mich.

BRIDGEPORT BRASS CO., Bridgeport, Conn., has moved its Philadelphia office from the North American Building, to the Bankers' Trust Building—No. 532.

MOTCH & MERRYWEATHER MACHINERY CO. has moved its Detroit offices from the Majestic Building into new quarters on the third floor of the Curtiss Building, 2842 Grand Blvd., which afford the company increased facilities for serving the interests of its customers.

CIA PRODUCTOS INDUSTRIALES, Apartado 370, Mexico, D.F., Mexico, has been organized for handling the sale of American small tools in Mexico by James McIntyre, who offers to exchange credit references with manufacturers of small tools who are seriously interested in the Mexican trade.

ATLANTIC TOOL & SALVAGE CO., 511 S. 16th St., Newark, N. J., has been formed with a view to operating a shop for cutter salvage, the work consisting of recutting, without annealing, all classes of milling cutters, including plain and side milling cutters, end milling cutters, and slitting saws.

ABRASIVE CO., manufacturer of grinding wheels and polishing grain, held its annual sales conference at its factory in Philadelphia on January 9 to 11, for the purpose of outlining the production and selling policy for 1924. The sales representatives from all sections of the country attended.

STANDARD GAUGE STEEL CO., Beaver Falls, Pa., discontinued its district office at 611 Harrison Bldg., Philadelphia, Pa., on January 1. The Edgcomb Steel Co., 11th and Cambria Sts., Philadelphia, will act as the company's exclusive agent in this territory, and will carry in stock a complete line of cold-drawn shafting, cold-drawn screw stock, flats, squares, hexagons and other specialties.

KEARNEY & TRECKER CORPORATION, Milwaukee, Wis., has made a change in its sales arrangements in the Cleveland territory. The company will continue its direct sales policy the same as heretofore, but has closed the store and showroom at 738 Superior Ave., N.W., Cleveland, and opened an office in the Penton Bldg., corner of West 3rd St. and Lakeside Ave. R. A. J. Wellington is in charge of the Cleveland office.

SOUTHERN RAILWAY CO. is planning the construction of extensive additions to the company's shops at Birmingham, Ala. The new shops will include locomotive repair shops, a boiler and smith shop, car repair sheds, together with power plant and other necessary buildings. Dwight P. Robinson & Co., Inc., 125 E. 46th St., New York City, have been awarded the contract for the design and construction of the shops.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburg, Pa., announces that its Cleveland branch and that of the Westinghouse Lamp Co. have consolidated their sales and service departments and warehouses in one building. The new five-story building, which is called the Westinghouse Electric Building, has 115 feet front on Ashland Road, and is 130 feet deep. It contains 14,500 square feet on each floor, and is of brick and concrete construction.

GENERAL ELECTRIC CO., Schenectady, N. Y., has created a southwestern district to handle its apparatus business in Texas, Oklahoma, southern New Mexico, and southeastern Arizona. The Southwest General Electric Co., as such, will continue to act as distributing jobber in the southwestern district. C. W. Hobson, has been appointed southwestern manager in charge of the business in that territory, and L. T. Blaisdell has been made district manager.

METALLURGICAL SERVICE CO., 405 Mercantile Library Bldg., Cincinnati, Ohio, has been formed to sell a complete line of metallurgical equipment and supplies to the industries in the Cincinnati district. The company will also give engineering advice and service on these products. This firm has been organized by N. M. Salkover, who is a graduate of the cooperative course in metallurgical engineering of the University of Cincinnati. He was formerly employed as metallurgist by the R. K. LeBlond Machine Tool Co.

WESTERN DROP FORGE CO., Marion, Ind., formerly a subsidiary of the R. L. Dollings Co., has been reorganized under the name of the MARION FORGED PRODUCTS CO. and resumed operation February 1. The new concern will manufacture forgings of carbon and alloy steels, brass, bronze, copper and aluminum, as well as a line of finished wrenches, chain pipe vises, hooks, clamps, etc. The officers are as follows: President, Frank W. Trabold; vice-president, Robert R. Batton; secretary, J. M. Wilson; and treasurer, F. W. Davis.

* * *

The annual meeting of the Taylor Society was held in the Engineering Societies' Building, 29 W. 39th St., New York City, January 24 to 26. Among the papers presented were the following: "A Critical Analysis of Scientific Management," by Henry H. Farquhar of the Harvard Graduate School of Business Administration; "Types of Management: Unsystematized, Systematized, and Scientific," by H. P. Kendall; "Scientific Management and General Administrative Control," by John H. Williams; and "Personnel Work in Scientific Management," by Mary Gilson.

COMING EVENTS

April 28-30—Annual meeting of the American Gear Manufacturers' Association at Buffalo, N. Y. Secretary, T. W. Owen, Room 107, 2443 Prospect Ave., Cleveland, Ohio.

April 30-May 2—Eleventh convention of the Society of Industrial Engineers in Buffalo, N. Y. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago, Ill.

May 19-21—Joint convention of the Southern Supply and Machinery Dealers' Association, the National Supply and Machinery Dealers' Association, and the American Supply and Machinery Manufacturers' Association, in Cleveland, Ohio; headquarters, Hotel Cleveland. Secretary-treasurer, F. D. Mitchell, 1819 Broadway, New York City.

May 26-29 (instead of 19-22)—Spring meeting of the American Society of Mechanical Engineers at Cleveland, Ohio. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

June 4-6—Eleventh annual foreign trade convention in Boston, Mass. O. K. Davis, India House, Hanover Square, New York City, secretary.

June 11-18—Convention and exhibit of Section V Mechanical, of the American Railway Association in Atlantic City, N. J.

June 11-18—Convention and exhibit of the Railway Supply Manufacturers' Association in Atlantic City, N. J. Secretary, J. D. Conway, 1841 Oliver Bldg., Pittsburg, Pa.

SOCIETIES, SCHOOLS AND COLLEGES

American Management Association, 20 Vesey St., New York City. Pamphlet containing a report of the Committee on Employment Plans relating to the selection of employes. The report was presented before the 1923 convention of the association, and the discussion that followed it is also included.

Compressed Air Society has published a pamphlet giving the trade standards that have been adopted by the society, embracing the nomenclature and terminology relating to air compressors and their operation. The booklet also contains a history of the development of speeds of air compressors, an explanation of capacities and pressures, instructions for the installation and care of air compressors, recommendations for lubrication and cleaning, and a description of the low-pressure nozzle test recommended by the society, as well as a partial list of applications of compressed air. Copies may be obtained from the secretary of the Compressed Air Society, C. H. Rohrbach, 50 Church St., New York City.

NEW BOOKS AND PAMPHLETS

History of Electric Light. By Henry Schroeder. 94 pages, 6 by 9¼ inches. Published by the Smithsonian Institution, Washington, D. C., as Publication No. 2717.

Temperature Requirements of Hot Spot Manifolds. By C. S. Kegerreis and O. C. Berry. 43 pages, 6 by 9 inches. Published by Purdue University, Lafayette, Ind., as Bulletin No. 15 of the Engineering Experiment Station.

A Study of Radio Signal Fading. By J. H. Dellinger, L. E. Whittemore, and S. Kruse. 38 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 476 of the Bureau of Standards. Price, 10 cents.

Patents, Trademarks, Labels, and Copyrights. By Joshua R. H. Potts, Attorney and Counsellor at Law, 8 S. Dearborn St., Chicago, Ill. 78 pages, 4 by 6½ inches.

This little pamphlet contains information on the laws concerning patents, trademarks, labels, copyrights, and unfair trade competition. Quotations from decisions of the courts have been selected that lay down the correct rule of law in such language as to make it clear to the layman.

Handbook of Practical Mechanics. By Charles H. Saunders. 251 pages, 4 by 6¼ inches. Published by the author, 31 Bay State Road, Boston, Mass. Price, $1.50.

This is the third edition of a little handbook for machinists and draftsmen, containing tables, rules, and formulas relative to thread-cutting, cams, bevel and worm gears, standard keys, bolts, tapping drills, metric system, weights of metals, speed of pulleys, tapers and angles, shop recipes, wire and plate gages, etc.

Rules for the Construction of Low-pressure Heating Boilers. 31 pages, 5¼ by 7¾ inches. Published as Section IV of the A. S. M. E. Boiler Code, by the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, 80 cents (to members of the society 70 cents) and in quantities of 25 or more, 65 cents.

This pamphlet comprises a report of the subcommittee of the Boiler Code Committee on Heating Boilers, and contains a revised code of rules for the construction of low-pressure steam heating, hot water heating, and hot water supply boilers. The steel plate section of this code embraces an important innovation in the form of special rules for the construction of low-pressure boilers with welded joints.

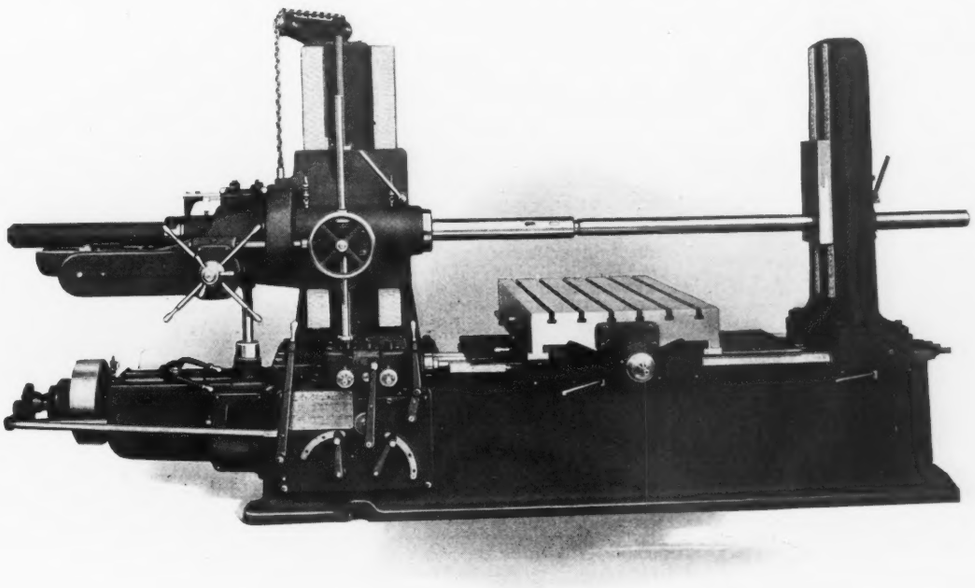
Henley's 222 Radio Circuit Designs. 271 pages, 5 by 8 inches; 284 diagrams and illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.

This little book treats of the design of radio receiving and transmitting circuits. The information given is intended to enable a novice to build and operate successfully any of the circuits included. It covers the complete electrical design of the circuits, showing the electrical values of inductances, capacities, and resistances, with the name of each element on the diagram of the circuit. The book gives complete descriptions of all types of circuits used in radio from the simplest crystal receiver to the most complex super-heterodyne, and from the simplest spark transmitter to the latest broadcasting station.

Machine Design—Drawing-room Problems. By C. D. Albert. 320 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $3.

This book is the outgrowth of the author's experience in teaching machine design to engineer-

The cost of repairs is part of the cost of production



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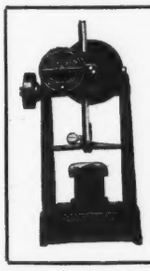

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ing students in the College of Engineering, Cornell University. It presupposes a knowledge of kinematics, mechanics, and engineering drawing. The purpose is to offer complete material for a drawing-room course in general machine design, and comprehensive problems are included. The material is divided into nine chapters, headed as follows: General Reference Chapter; Materials; Factor of Safety and Allowable Stress; Pump Problems; Slide Valve and Valve Gear Diagrams; Steam Engine Flywheel; Combination Punch and Shear; Balancing Problem; and Upright Drilling Machines.

Lathes: Their Construction and Operation. By George W. Burley. 231 pages, 4½ by 7½ inches. Published by Scott, Greenwood & Son, 8 Broadway, Ludgate, London, E.C., 4, England.

This is the second revised edition of a book on the construction and operation of lathes. The book begins with a description of the evolution of the lathe, and then proceeds to a classification of modern lathes, including hand lathes, engine lathes, turret lathes, vertical lathes, and special types. The following five chapters describe in detail each of these types of lathes, after which come chapters on lathe accessories, lathe cutting tools, lathe work, and cutting speeds and feeds. The appendix contains tables of screw threads that can be cut on Hendey-Norton lathes; change-gears for cutting English threads; and change-gears for cutting metric threads.

Aeronautical Science. By Ivor B. Hart and W. Laidler. 288 pages, 5 by 7½ inches. Published by the Oxford University Press, American Branch, 35 W. 32nd St., New York. Price, $2.75.

This book has been brought out to meet the need for an elementary scientific treatise on the subject of aeronautical science. In order to follow the text intelligently, the student requires only a knowledge of elementary algebra and trigonometry. The authors are engaged in the instruction of aircraft apprentices of the Royal Air Force in England, and it was primarily for these young students that the book was written. The book is divided into three parts dealing, respectively, with a historical survey, and a summary of the facts and formulas of elementary mechanics; the elementary principles of flight; and the structure of the airplane.

Technical Writing. By T. A. Rickard. 337 pages, 5 by 8 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $2, postpaid.

This is the second edition of a book originally written to instruct engineering students in the correct use of the English language. The book has been rewritten and enlarged. In the new edition a discussion of the subjunctive and the use of shall and will is included, and a chapter entitled "The Wrong Word" has been added. Another new chapter is that on punctuation. While written primarily for engineering students, this book will be found of value to all those who desire to obtain a thorough grounding in English. Those who have occasion to contribute to the technical press will find this book especially helpful, as it takes up many of the points in grammar, construction, and punctuation that are puzzling to the majority of people. Two chapters, in particular, that will repay careful study are those on prepositions and on relative pronouns.

Power Plant Machinery—Volume I. By Walter H. James and Myron W. Dole. 277 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $3.

This is the second edition of the first volume of a work dealing with power plant machinery, the purpose of the authors being to present, in these two volumes, a general discussion of the principal machines used in a steam power plant, not including the boilers, stokers, coal, or ash handling machinery. Volume I deals with the steam engine from a kinematic standpoint, describing the principle of operation of both reciprocating engines and turbines, and treating at some length of the design of valve gears for reciprocating engines. The nature and purpose of the indicator card are described, and the card is used to show the relation between the steam distribution and the design of the valve gear. In this edition a brief description of the planimeter has been added, including an explanation of its use but avoiding a mathematical discussion of the principles upon which it operates. Additional examples are given of modern hand-controlled valve gears, particularly as applied to locomotives. The chapter on turbine governors has been entirely rewritten and new examples have been selected. A set of problems for solution by the student has been added, in order to make the book more valuable for class-room use.

NEW CATALOGUES AND CIRCULARS

Whitman & Barnes Mfg. Co., Akron, Ohio. Stock list of the complete line of Whitman & Barnes twist drills and reamers.

Lapointe Machine Tool Co., Hudson, Mass. Leaflet illustrating and describing the Lapointe No. 3 improved duplex broaching machine.

National Tool Co., Cleveland, Ohio. Circular containing general description, illustrations, and price lists of "Save All" chucks, and collets for use with these chucks.

Chandler & Farquhar Co., 250 Devonshire St., Boston, Mass., dealer in gears, hardware, metals, radio equipment and tools, is distributing a calendar for 1924 to the trade.

Bristol Co., Waterbury, Conn. Bulletin 323, illustrating and describing the Bristol-Derr recording water level gage for steam boilers, and indicating water level gage.

Kardon Products Co., 101 Varick St., New York City. Catalogue 600 and guide book, featuring the most prominent hook-ups for radios used in connection with the Kardon units.

Baird Machine Co., Bridgeport, Conn. Circular illustrating and describing Baird automatic wire-forming machines, presses, chucking machines, tumbling barrels, and accessories.

Lamson Co., Inc., Syracuse, N. Y. Bulletin describing a new Lamson conveyor and production control system installed in the plant of the Eureka Vacuum Cleaner Co., Detroit, Mich.

Edgar T. Ward's Sons Co., Newark, N. J., is issuing a monthly publication known as "The Shaft," for the purpose of informing its customers of the policies and products of the company.

Link-Belt Co., Chicago, Ill. Calendar for 1924 arranged with three months on each sheet and illustrated by halftones and pen-and-ink sketches showing different applications of Link-Belt silent chain drive.

Oilgear Co., 398-406 38th St., Milwaukee, Wis. Bulletin 30, containing specifications for the new line of Oilgear self-contained broaching and assembling presses, which are built in 15-, 25-, and 50-ton capacities.

Sigourney Tool Co., Hartford, Conn. Circular containing illustrations and brief descriptions of the Sigourney ball-bearing drill presses, which are made in different styles with one, two, three, and four spindles.

Diamond Drill Contracting Co. of California, Haas Bldg., Los Angeles, Cal. Pamphlet descriptive of the Fred Stone equipment for deep well drilling and its use in drilling 4,000,000 feet of holes during the last thirty years.

Mehl Machine Tool & Die Co., Roselle, N. J., tool service engineers, are distributing a calendar for 1924. The numbers are printed in large type, so they may be seen at a distance, and the calendar is arranged with three months on each sheet.

Lufkin Rule Co., Saginaw, Mich. Catalogue 11, containing dimensions, price lists, and other data pertaining to the Lufkin line of measuring tapes, rules, and mechanical tools, including micrometers, protractors, combination squares, dividers, calipers, depth gages, etc.

Alexander Milburn Co., 1416 W. Baltimore St., Baltimore, Md. Pamphlets covering the Milburn welding and cutting apparatus and Milburn carbide lights for construction and emergency lighting. Copies of these pamphlets will be mailed upon request to those interested.

General Welding & Equipment Co., 74 Brookline Ave., Boston, Mass. Circular descriptive of the automatic cutting machine made by this concern, which is equipped with a torch for cutting locomotive frames, machine parts, and plate work, and has a cutting range of 2 by 4 feet.

Whiting Corporation, Harvey, Ill. Bulletin N-1346, of Whiting power-house cranes, showing a number of installations of different sizes and types. Bulletin N-1387, illustrative of the savings in labor effected by the use of Whiting charging machines, as compared with hand charging of cupolas.

Oilgear Co., Milwaukee, Wis. Circular illustrating installations of Oilgear broaching and assembling presses in a number of plants, and describing the savings that have been effected by their use. Bulletin 30, containing specifications of Oilgear 15-, 25-, and 50-ton broaching and assembling presses.

Reeves Pulley Co., Columbus, Ind. Catalogue T-44, descriptive of the Reeves variable-speed transmission which is designed to give adjustable speeds to any type of machine. The catalogue explains how the transmission operates, describes its construction, and illustrates its application in various fields. Complete price lists are included.

C. F. Pease Co., 885 N. Franklin St., Chicago, Ill. Catalogue C-24, containing 32 pages of data on the drawing instruments made by this concern, including ruling pens, bow instruments, compasses, steel trammels, dividers, etc. Descriptions and prices are given for the separate instruments as well as for sets of different combinations.

Driver-Harris Co., Harrison, N. J. Catalogue R-24, of nichrome and other alloys for electrical resistance. The book describes these alloys and their application, and gives temperature resistance curves for nichrome wire. Complete tabular matter is included, covering temperature characteristics of nichrome resistance wire, prices, sizes, etc.

Hill, Clarke & Co. of Chicago, 649 W. Washington Blvd., Chicago, Ill. Circular containing a list of the remanufactured machine tools that this company has to offer, including lathes, drilling machines, shapers, horizontal and vertical boring machines, milling machines, gear cutters, grinders, turret and screw machines, planers, presses, and miscellaneous machines.

Winfield H. Smith, 10 Lock St., Buffalo, N. Y. Catalogue 21, illustrating and describing a line of light power transmission machinery. Particular attention is called to the enlarged line of speed reducing gears for transmitting up to three horsepower. The small hangers, pillow blocks, and pulleys described are of special interest to experimenters and experimental laboratories.

Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago, Ill. Catalogue AR, of Hannifin air-operated arbor presses, which are especially adapted for assembling and broaching operations, the work being accomplished in one continuous stroke. The catalogue contains detailed line illustrations and specifications of the different sizes. Illustrations are included showing these presses in operation on various classes of work.

Grant Gear Works, 151 Pearl St., Boston, Mass. Catalogue and price list of the line of gears made by this concern, which includes iron cut gears, brass cut gears, cast gears, and special gear wheels. Considerable general information on gearing is given, including data on computing sizes of gears, tables of diametral and circular pitches, bevel gear chart, Grant's involute odontograph, instructions for drawing different types of gear teeth, etc.

Oliver Machinery Co., Grand Rapids, Mich. Catalogue 22, of Oliver wood-working machinery and factory supplies, as well as engine lathes and die filers for metal-workers. Specifications are given for saw benches, cut-off saws, band saws, surfacers, hand planers and jointers, pattern and other lathes, disk and belt sanders, multiple borers, universal wood milling machines, mortisers, etc. Copies of this catalogue will be sent upon request to those interested in these products.

Van Keuren Co., 12 Copeland St., Watertown, Boston 72, Mass. Pamphlet devoted to the three-wire measurement of National or U. S. standard screw threads. Data are included covering the best size measuring wires for standard pitch threads from 4 to 80 per inch, and additional information for determining the pitch diameter of screw threads by the three-wire method. The pamphlet also contains suggestions regarding the use of wires with light waves, as well as with mechanical measuring devices.

Cleveland Twist Drill Co., Cleveland, Ohio. Catalogue 40, containing 226 pages, covering this company's complete line of drills, reamers, sockets, counterbores, mills, screw extractors, arbors, mandrels, and high-speed tools. Among the new tools shown in this catalogue are the "Cle-Forge" high-speed drill, the "Mezzo" super-carbon drill, and the "Quick-Set" adjustable reamer. The catalogue is conveniently arranged with a thumb-index, which facilitates reference to the different sections, and a classified index is included.

Fafnir Bearing Co., New Britain, Conn. Catalogue 21, printed in two colors, covering the complete line of Fafnir ball bearings. A brief description is given of the manufacture of these bearings, following which there is a discussion of the different types and how to mount them, as well as instructions for cleaning and lubricating, including examples of types of closures employed. The second part of the book contains tables giving sizes, dimensions, load ratings, and prices of the different types of bearings, as well as tables of standard fits for ball bearing mountings.

Industrial Works, Bay City, Mich., has brought out a book (No. 115) on cranes, commemorating the fiftieth anniversary of the foundation of the works. On account of being an anniversary edition, neither care nor expense has been spared in the preparation of the book. Each section showing different types of cranes is headed with a color plate. The book opens with a history of cranes, illustrated with pen-and-ink sketches on a green background. Following the introduction there are six sections, illustrating and describing, respectively, locomotive cranes; locomotive crane accessories; wrecking cranes; special railway equipment; pile drivers; and cranes especially designed for handling equipment in foreign countries.

E. C. Atkins & Co., Indianapolis, Ind. General catalogue 19, containing 268 pages, 7 by 10 inches, illustrating and describing Atkins silver steel saws, saw tools, saw specialties, machine knives, grinding wheels, metal-cutting machinery, etc. In preparing this catalogue, careful attention has been given to the general arrangement in order to make it convenient for reference, and a complete index has been included. In addition to a general description of the various products and specifications, instructions are given for ordering, where necessary. Tables of repair parts, as well as a variety of information of value to those interested in this class of products, are included. The book is profusely illustrated with halftone illustrations of the different tools. Copies of this catalogue will be furnished to any reader who is engaged in the lumber, furniture, or woodworking business.